

# Shifts in agrarian entrepreneurship in mid-Victorian England and Wales\*

by Piero Monteburno, Robert J. Bennett, Carry van Lieshout,  
Harry Smith and Max Satchell

## *Abstract*

This paper provides the first full-population analysis of changes in the entrepreneurial status of farmers during the mid-nineteenth century: between being employers or sole proprietors with no workforce. Using a unique dataset of all farmers and workforces in the 1851–81 English and Welsh censuses, this paper explores the effects of changes in agriculture on entrepreneur choices. A short ‘Golden Age’ was followed by increasing technical changes and the onset of agricultural depression causing an important shift in agricultural entrepreneurial activity: initially the employer proportion increased slowly, but from the 1860s employers reduced labour and more worked as sole proprietors. Our findings show that farmers were adaptable and resilient to change through shifts in entrepreneurial status and/or greater involvement of the family, supporting the conclusions of earlier researchers who took an optimistic interpretation of flexibility and robustness of farmers. We also show the adaptations to be highly geographically variegated, depending on land quality, distance to local markets, and rail lines.

This paper uses a new whole-population database for all farmers in England and Wales over 1851–81, which allows the first systematic national analysis of farmers’ entrepreneurial status at four data points. The paper draws on the original census records which are now available as a digital resource. The reliance on the published census tables, and various defects that have previously held back use of the records, can now be mostly overcome. We use the new data to examine how farmers adapted to the changing circumstances of the period through their form of proprietorship: as employers of waged labour or as sole proprietors farming on their own account, sometimes supported by family labour.

British agriculture underwent a dramatic change in the mid-nineteenth century. In the previous two centuries it had witnessed sustained growth. Between 1700 and 1850, output increased by between 100 and 172 per cent, land under cultivation increased by about

\* This research has been supported by the ESRC under project grant ES/M010953: *Drivers of entrepreneurship and small businesses*. Extraction and coding of the data for 1871 was assisted by Joe Day and supported by Isaac Newton Trust Grant 17.07(d) *Employers in 1871*. Extraction of 1881 data was initially undertaken by Gill Newton, supported by Leverhulme Trust grant RG66385: *The long-term evolution of small and medium-sized enterprises (SMEs)*. For acknowledgments of the data sources employed in this paper, please see Appendix II.

25–33 per cent, capital inputs nearly doubled and labour productivity increased substantially.<sup>1</sup> This changed dramatically during the mid-nineteenth century. The new data allow these changes to be examined for their effect on proprietor status. As has been well understood, there was a brief ‘Golden Age’ for farming up to the 1860s, followed by an agricultural depression that extended from 1873 to 1896.<sup>2</sup> Whilst it has also been well known that between 1851 and 1911 the number of people involved in farming fell from 1.7 million to 1.2 million, and agriculture’s share of national income fell from around 20 per cent to 6 per cent,<sup>3</sup> there has been little attention paid to how farms as businesses changed their organizational status. The new data allow this issue to be unravelled.

Entrepreneurial status is a neglected aspect of how farmers responded to changing conditions. This has, in many ways, been the result of the lack of sufficient information.<sup>4</sup> For instance, Collins observed that ‘little is known in detail about farmers as an entrepreneurial group’.<sup>5</sup> Clark directly confronted the changes in entrepreneurial status over time as a response variable, arguing that, while the proportion of proprietors in agriculture declined with economic development over the nineteenth and twentieth centuries in England and Wales as other industries expanded, ‘within agriculture itself ... the proportion of working proprietors often tends to increase’.<sup>6</sup> However, he was not able to pursue the implications of his finding further. More generally, where discussed, agricultural entrepreneurs have been interpreted as an aspect of Britain’s more general supposed entrepreneurial failure, with farmers criticized for not adapting quickly enough to changing circumstances.<sup>7</sup> The important distinction we can now examine is between farmers who ran their own businesses as an employer of others, and those operating on their own account as an individual with no other formal or regular labour inputs. We use the term ‘own account’ as this was the terminology used in the census: the phrase was also widely used outside farming. The modern equivalent is ‘self-employed’, people operating on their own account. The term, with this definition, is used in modern censuses,

<sup>1</sup> R. C. Allen, ‘The growth of labor productivity in early modern English agriculture’, *Explorations in Economic Hist.*, 25 (1988), pp. 117–46; R. C. Allen, ‘Labor productivity and farm size in English agriculture before mechanization: Reply to Clark’, *Explorations in Economic Hist.*, 28 (1991), pp. 478–92; J. Burnette, ‘Agriculture, 1700–1870’, in R. Floud, J. Humphries and P. Johnson (eds.), *The Cambridge economic history of modern Britain*, I, 1700–1870 (2014), pp. 89–117; G. Clark, ‘Labor productivity and farm size in English agriculture before mechanization: A note’, *Explorations in Economic Hist.*, 28 (1991), pp. 248–57. M. E. Turner, ‘Agricultural output, income and productivity’, in E. J. T. Collins (ed.), *The Agrarian History of England and Wales*, VII, 1850–1914 (2 vols, 2000) [hereafter *AHEW VII*], (i) pp. 224–319; and E. J. T. Collins, ‘Rural and agricultural change’, in *AHEW VII* (i), pp. 73–223.

<sup>2</sup> R. Perren, *Agriculture in depression, 1870–1940* (1995), pp. 7–30.

<sup>3</sup> M. Turner, ‘Agriculture, 1860–1914’, in R. Floud

and P. Johnson (eds.), *The Cambridge economic history of modern Britain*, II, *Economic maturity, 1860–1939* (2004), pp. 133–60.

<sup>4</sup> Farmers themselves are oddly understudied as a group, although see R. W. Hoyle (ed.), *The farmer in England, 1650–1980* (2013) and G. E. Mingay, ‘The farmer’ in *AHEW VII*, (i), pp. 759–809.

<sup>5</sup> Collins, ‘Rural and agricultural change’, p. 167.

<sup>6</sup> C. Clark, *The conditions of economic progress* (1957), pp. 495–6.

<sup>7</sup> For mild criticism see M. Daunton, *Wealth and welfare: An economic and social history of Britain, 1851–1951* (2007), pp. 48–9; for stronger criticism see P. J. Perry, *British farming in the Great Depression, 1870–1914: An historical geography* (1974); for a defence see E. H. Hunt and S. J. Pam, ‘Responding to agricultural depression, 1873–96: managerial success, entrepreneurial failure?’, *AgHR* 50 (2002), pp. 225–52. Collins, ‘Rural and agricultural change’, pp. 167–75 summarizes many of the arguments.

the Labour Force Survey, and other sources. Whilst discussions in agricultural history often distinguish between employers as 'capitalist farmers' and own account as 'peasants', both terms are misleading for England and Wales after the 1850s, which had very few subsistence peasants and almost all farmers traded in the market.

The census definition has the advantage that it was deliberately held at a point in the year when there was little need for seasonal labour. A farmer is therefore only recorded as an employer if employing workers all year round; while an own-account farmer was able to run the farm on his own for most of the year. Whilst there are some uncertainties in the census about how far part-time, seasonal labour, and the retired were included, as discussed further below, the instructions make it clear that for women, only those 'regularly employed' were to be recorded, and 'farmer's son' or 'farmer's daughter' were to be returned only if 'employed'.<sup>8</sup> These distinctions were adjusted in some census publications, but we use the original census responses where the instructions are the key determinant of what was included. The census data we are using should normally distinguish employers who had formal long-term labour, from own account who had either no labourers or depended on their family for occasional inputs that were not being used on the date.

However, we recognize that the distinction between employers and own account can be confused because in farming (as well as other businesses) many labour inputs will be not fully recorded where provided within family farms by a spouse, family member or through social networks that are informal, occasional or are required only for brief peak periods such as harvesting. Errington and Gasson refer to the flexibility that these family farms offer in weathering hard times and offering durability through changing social and economic circumstances.<sup>9</sup> Family offered flexible and casual assistance between pure own-account and employer status, and can also facilitate business succession.<sup>10</sup> As Hibbard noted, this flexibility was crucial: 'farmers will do anything possible to avoid hiring men' on a permanent basis.<sup>11</sup> Indeed, the concept of a 'family size farm' is long-established. In countries like the central USA in the 1940s this was 15–120 acres on poorer land, or 165–200 acres on better land. In Europe in the 1950s it was 100–300 acres.<sup>12</sup> In England and Wales Grigg showed that the average farm size continued at about 80 acres from the 1880s until the 1950s, but medium-sized farms (which he equated to family-owned) of 100–300 acres increased in number and proportion until the 1950s, and did not show marked decline until the 1980s.<sup>13</sup> These sizes could be operated by a

<sup>8</sup> E.g. BPP, 1854. *Census of England and Wales for the year 1851, General Report: 'General Instructions' to farmers, and to women and children*, p. 14. E. Higgs, 'Occupational censuses and the agricultural workforce in Victorian England and Wales', *EcHR* 48 (1995), pp. 700–16; E. Higgs, *Making sense of the census* (2005).

<sup>9</sup> A. Errington and R. Gasson, 'Labour use in the farm family business', *J. Agricultural Economics* 34 (1994), pp. 293–307.

<sup>10</sup> R. Gasson, G. Crow, A. Errington, J. Hutson, T. Marsden, and D. M. Winter, 'The farm as a family business: A review', *J. Agricultural Economics* 39 (1988), pp. 1–41; C. Potter and M. Loble, 'The farm family

life cycle, succession paths and environmental change in Britain's countryside', *J. Farm Economics* 47 (1996), pp. 172–90. See also M. Anderson, *Family structure in nineteenth-century Lancashire* (1971); L. Davidoff and C. Hall, *Family fortunes: men and women of the English middle class, 1780–1850* (rev. edn, 1997).

<sup>11</sup> B. H. Hibbard, *Agricultural economics* (1948), p. 130.

<sup>12</sup> *Ibid.*, pp. 71–5; W. A. Lewis, *The theory of economic growth* (1955), p. 134.

<sup>13</sup> D. Grigg, 'Farm size in England and Wales, from early Victorian times to the present', *AgHR* 35 (1987), pp. 179–89.

single individual as a true own account, or as a *de facto* own account with occasional inputs from family members who were not counted as formal employees. Above these sizes, or at some smaller sizes depending on land quality and potential for intensification, continuous or near-continuous employment of others as labourers or machine operatives is required. Indeed, in nineteenth-century England and Wales family farms were mainly important in the north of England and were rarer elsewhere.<sup>14</sup> Hence the possibility of unmeasured family inputs is borne in mind in the interpretation below.

This paper focuses on entrepreneurial distinctions, but also takes account of interactions with a wider set of influences on farmers of their demographic and family status (such as gender, marital status, availability of family members), the land quality of their farms, access to markets, and the potential (over time) to adjust farm size. As we explained, the paper exploits a new whole-population database for all farmers in England and Wales over 1851–81. This database is at the individual level for over 150,000 farmers per census year and can be analysed at various geographical scales; here we use 623–630 registration districts (RDs) and 15,297–16,395 parishes; we also use a panel of 11,764 continuous parish units which are each aggregated to a common boundary to remove any effects of boundary changes. The analysis covers all parishes and RDs in England and Wales, but the numbers that contain farmers vary a little between years due to urbanization and any data gaps, as reported in the tables and discussed further below. The national coverage of the dataset for individual farmers allows us to examine questions that could previously only be addressed using the tables published by the General Record Office (GRO), which were limited in scope, were affected by data-editing (especially affecting women), and are only fully available for 1851. Individual-level data over four census years offers the opportunity to examine how entrepreneur status developed in a period where agriculture experienced many technical changes and had been opened to unfettered price competition through removal of tariff and market barriers.

The paper first introduces the significance of the period examined and the database used. Section II discusses the challenges of the census data and how they have been overcome. Section III presents analysis of entrepreneurial status and estimates cross-sectional models of the main influences on entrepreneurial status. Section IV extends the estimates to panel data based on continuous parishes, which confirms the robustness of the cross-section estimation. The paper confirms that the likelihood of farmers being employers significantly declined after 1861. The probability of being an employer was also higher on the better-quality land and closer to markets and transport access. Demographic and family structure interacted with these changes, allowing the shift to a greater proportion of own-account farmers in more marginal areas and where the possibility of using spouse and other family labour was available to avoid paying workers, and/or by diversifying into lodging provision.

<sup>14</sup> L. Shaw-Taylor, 'The rise of agrarian capitalism and the decline of family farming in England', *EcHR* 65 (2012), p. 51.

## I

A critical change occurred for British agriculture after 1846–49, at the start of our analysis in 1851, when the repeal of the Corn Laws removed all restrictions and protective tariffs on food imports, and reform of the Navigation Laws removed restrictions on access by foreign shipping. The main immediate effect was to remove limits on grain imports. British farmers and the agricultural lobby agitated against this. Nevertheless, initially agriculture prospered and the period has been referred to as ‘the Golden Age of British Agriculture’.<sup>15</sup> These changes have been discussed at great length in studies of agricultural history.<sup>16</sup> In summary, grain prices initially rose, mainly as a result of growing population demand and delays in the onset of competition from the great producers in Europe and America during the Crimean War and the American Civil War. However, from the early 1870s the price of grain in Britain fell dramatically as a result of cheap bulk imports from America as railways opened up the prairies and shipping rates were cut.<sup>17</sup> The subsequent period is often referred to as the ‘Great Depression’ in agriculture, lasting until about 1896.<sup>18</sup>

However, whatever the strength of the depression, there were other factors at work, many of which began in the 1850s and 1860s, as indeed we find for entrepreneurship below. There were important technical developments of labour-saving farm equipment, and improvements in fertilizers, seed, pest control and other techniques.<sup>19</sup> Changes in taste interacted with prices which together increased demand for meat: contemporaries noted that ‘the sort of man who had bread and cheese for his dinner 40 years ago now demands a [meat] chop’; resulting in a 300 per cent increase in meat imports.<sup>20</sup> There was a run of bad seasons. And there were reductions in farm profits and rental incomes that among other things reflected growing pressures of wage competition from industry, and widening differences in returns to be gained from agriculture compared to industrial investments. Moreover, these had differing impacts between types of farms and regions: most significant was a decline in the value of output relative to costs (primarily rent and wages) of grain producers and regions, which was less significant for livestock farmers and those closest to urban demands.<sup>21</sup>

<sup>15</sup> R. Prothero, *English farming, past and present* (1912).

<sup>16</sup> See recent review by Collins, ‘Rural and agricultural change’, pp. 73–200; Turner, ‘Agricultural output, income and productivity’, pp. 72–224.

<sup>17</sup> R. Lawton and C. G. Pooley, *Britain, 1740–1950: An historical geography* (1992), pp. 144–5; N. Koning, *The failure of agrarian capitalism: Agrarian politics in the United Kingdom, Germany, the Netherlands and the USA, 1846–1919* (1994), pp. 72–80; Collins, ‘Rural and agricultural change’; R. Perren, *Taste, trade and technology: The development of the international meat industry since 1840* (2006), pp. 19–23, 40–51; C. Ó Gráda, ‘British Agriculture, 1860–1914’, in R. Floud and D. McClosky (eds.), *The economic history of Britain since 1700* (sec. edn, 1994), pp. 146–72; Turner, ‘Agricultural output,

income and productivity’, pp. 140–4.

<sup>18</sup> T. W. Fletcher, ‘The great depression of English agriculture, 1873–1896’, *EcHR*, 13 (1961), pp. 417–32.

<sup>19</sup> N. Verdon, *Working the Land: A history of the farmworker from 1850 to the present day* (2017), pp. 76–80; and extensive reviews in the chapters in Collins ed., *AHEW*, Chapters 6–9.

<sup>20</sup> P. Graham, *The revival of English agriculture* (1899); Perren, *Taste, trade and technology*, pp. 9, 79–80.

<sup>21</sup> J. R. Bellerby, *Agriculture and industry: Relative income* (1956), pp. 56–8; C. H. Feinstein, *National income, expenditure and output of the United Kingdom, 1855–1965* (1972), Tables 8 and 23. Turner, ‘Agricultural output, income and productivity’: pp. 224–320 assesses the various estimates and provides a revision.

In areas more reliant on cereal production, in the south and east of England, especially counties such as Oxfordshire and Berkshire, output fell by 20 per cent between 1873 and 1894. In the more pastoral north and west, notably Lancashire and Cheshire, output increased.<sup>22</sup> Previous studies of the geography of these changes have relied on small-scale datasets (such as bankruptcies) and have usually been restricted to county-level analysis. One major advantage of the data used here is that it reveals the geography of agriculture in finer detail than has been previously possible, for the whole country and for parishes and individuals, rather than just certain counties or particular regions, and permits us to drill down into changes in entrepreneurial structure.<sup>23</sup> The period which we examine, 1851–81, thus covers two phases, a short period of with steady or slow growth in farming opportunities, and a second phase where technical and other changes began to become significant from the 1860s, intensifying after about 1873 as a result of price and cost pressures on grain and in some parts of the country.

A major impact of the changes was to intensify the ongoing reduction in size of the agricultural workforce. The total farm labour force declined by 22.5 per cent from 1.48m in 1851 to 1.15m by 1881, against a background of rapidly rising total population numbers. Yet the number of farmer proprietors reduced by far less. As noted in previous discussions the number of farmers stayed remarkably stable across the mid- to late nineteenth century.<sup>24</sup> In our estimates derived from the census, farm proprietors reduced by 10.6 per cent, from 210,254 in 1851 to 187,988 in 1881. Indeed, Lawton and Pooley observe that ‘the achievements of British farming from the 1830s to the mid-1870s were impressive’, with further developments maintaining steady progress in farming until prices recovered in the late 1890s.<sup>25</sup>

The shift between different types of proprietor is an important aspect of adaptation which has not been previously fully examined but on which we can now report. Figure 1a shows the aggregate changes in numbers evidenced by the new data we use in this paper, and Figure 1b expresses this as an index. The actual numbers behind these figures are given in Table 1. The fall in farm workers was continuous, but the rate of decline increased rapidly after 1861. Employer numbers also began to decline rapidly after 1861 and this continued subsequently.<sup>26</sup> Conversely, own-account farming, which had been fairly stable between 1851 and 1861, began to increase rapidly after 1861 and then levelled off. Change was much more marked for own account, indicating farmers substituting for employed workers as employer numbers declined, rather than leaving the market; this is emphasized by the indexed changes in Figure 1.b.

<sup>22</sup> F. M. L. Thompson, ‘An anatomy of English agriculture, 1870–1914’, in B. A. Holderness and M. Turner (eds), *Land, labour and agriculture, 1700–1920: Essays for Gordon Mingay* (1991), pp. 230–1; Collins, ‘Rural and agricultural change’, p. 144.

<sup>23</sup> For previous geographies, see P. J. Perry, ‘Where was the “Great Agricultural Depression”? A geography of agricultural bankruptcy in late Victorian England and Wales’, *AgHR* 20 (1972), pp. 30–45; D. Grigg, *English agriculture: an historical perspective* (1989); M. Overton, ‘Re-establishing the English agricultural revolution’, *AgHR* 44 (1996), pp. 1–20. Thompson, ‘Anatomy’,

pp. 224–31; the geography is also examined in the chapters by Hallas, Holderness, Moore-Colyer, Holderness and Mingay, Walton, and Wilmot in Collins (ed.), *AHEW*, VII (i), ch. 5. Much of this commentary confirms the division between grain and grazing suggested by Caird in 1852, see J. Caird, *English Agriculture in 1850–51* (1852), frontispiece.

<sup>24</sup> Grigg, *English agriculture*, ch. 9; Collins, ‘Rural and agricultural change’, pp. 167–8.

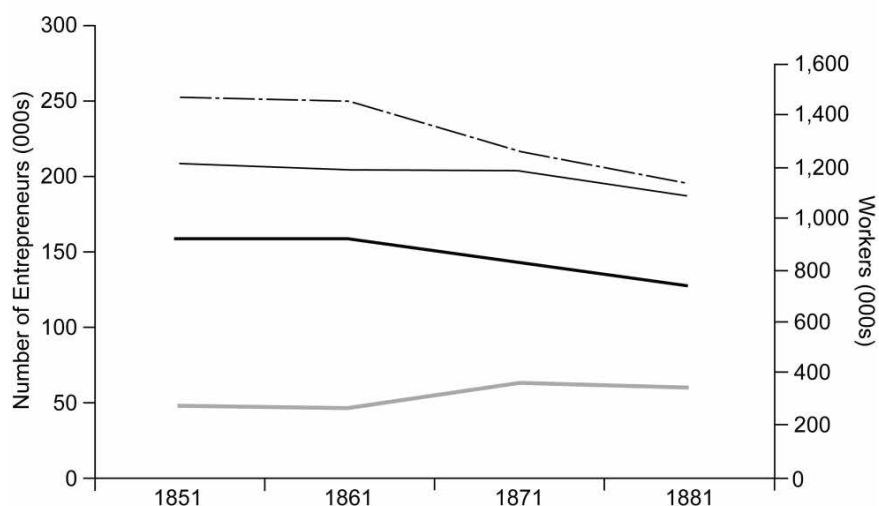
<sup>25</sup> Lawton and Pooley, *Britain, 1740–1950*, p. 139.

<sup>26</sup> This figure includes all self-reported farm workers, not the number reported as employees by farmers.

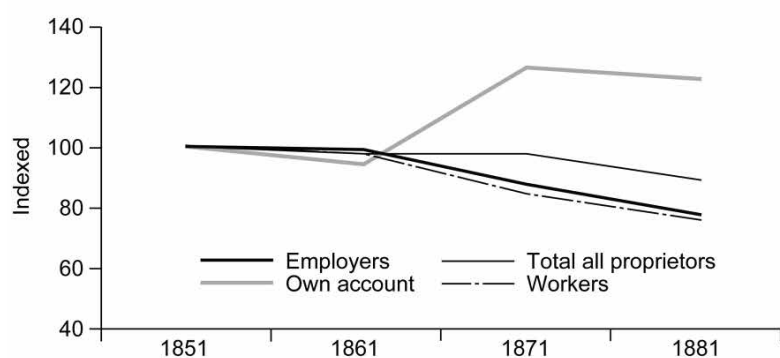


FIGURE 1

a. Change in numbers of farm proprietors by type, and farm workers;



b. Changes in farm proprietors by type indexed to 1851 = 100.



Source: Authors' calculations from I-CeM/S&N data.

TABLE 1. Number of farm proprietors by type, and farm workers (as used in Figure 1)

|                       | 1851      | 1861      | 1871      | 1881      |
|-----------------------|-----------|-----------|-----------|-----------|
| Employers             | 160,640   | 159,061   | 142,385   | 127,119   |
| Own account           | 49,614    | 47,494    | 62,825    | 60,880    |
| Total all proprietors | 210,254   | 206,555   | 205,210   | 187,999   |
| Workers               | 1,482,007 | 1,456,015 | 1,264,335 | 1,148,814 |

Source: Authors' calculations from I-CeM/S&N data.

While from the 1870s the agricultural depression thus had effects on the form of farm entrepreneurship, a reduction in employer numbers and a shift to own account was part of an organizational change that began earlier. Many former employers shed workforce to the point that they no longer had any permanent employees, becoming instead own-account proprietors. The 1871 census report primarily ascribed this to technical change. Recognizing a fall in number of employers and a rise in own-account farmers between 1851 and 1871 in a

sample of counties, they concluded that as agricultural production had increased over this period, 'human labour is being replaced by machinery, [so that] the proportion of that labour consumed in any given agricultural product becomes every year less'.<sup>27</sup> As Koning concluded for the period, this 'was not really a period of stagnation. Rather, it was a period of profound structural change'.<sup>28</sup> The new data indicate that one of the structural changes that has been previously neglected was the entrepreneurial status of farmers.

The entrepreneurial trends can be compared with aggregate trends in farm output levels. Although the census lacks such data, the *Agricultural Statistics* allows tracking from 1866 of the general output trend. Ojala and Bellerby, using these statistics for sample areas, calculated gross output, costs and net output or agricultural income for the United Kingdom.<sup>29</sup> Their data, extended by Turner, shows first an increase and then a decrease in profits parallel to the 'Golden Age' and the depression.<sup>30</sup> Feinstein's series, which were derived from tax records and adjustments to Bellerby, show that agricultural output remained fairly stable over the whole period 1855–81, but with a peak in 1868–70. Farm profits, however, rose to a peak of £55m in 1873 and then declined dramatically to only £13m by 1879, subsequently recovering only slowly.<sup>31</sup> Hence, whilst profits were under great pressure, gross output estimates for the period show farm production to have been remarkably resilient.<sup>32</sup> This was achieved through major structural adjustments by farmers, including the adjustment we focus on: the entrepreneurial decision to hire less labour. But Figure 1 shows the start of entrepreneurial shifts to have pre-dated the major economic effects of the depression.

## II

The role of entrepreneur status in the changes in farming can now be examined for the first time at the individual level for each farmer in the entire population using data that has become available from the historic population censuses. As noted by Grigg the censuses provide 'the only *comprehensive* survey of the size of farms in England and Wales' for this period.<sup>33</sup> However, the comprehensive results collected on farm entrepreneurs were not fully published by the census administrators with the result that Grigg and others were not able to use them in any depth. Mapping has been undertaken for 1851, the only year fully published at county level, by Grigg, Lawton and Pooley, and Shaw-Taylor.<sup>34</sup> The deficiency of published material has recently been overcome through an electronic version of the original individual census records becoming available through *The Integrated Census Microdata* (I-CeM) for 1851–61 and

<sup>27</sup> BPP, LXXI (1873), Census of England and Wales, 1871, General Report. IV, p. xlviii.

<sup>28</sup> Koning, *Failure of agrarian capitalism*, p. 71.

<sup>29</sup> E. M. Ojala, *Agriculture and economic progress* (1952); Bellerby, *Agriculture and industry*.

<sup>30</sup> Bellerby, *Agriculture and industry*, pp. 56–84; Turner, 'Agricultural output, income and productivity', pp. 224–320, and B. Afton and M. Turner, 'Agricultural output', *AHEW*, VII (ii), Table 38.7; Collins, 'Rural and agricultural change', p. 74.

<sup>31</sup> Feinstein, *National income, expenditure and output*, Tables 8 and 23: T24 and T60; see also Turner's discussion of Feinstein, 'Agricultural output, income and productivity', pp. 272–5.

<sup>32</sup> Lawton and Pooley, *Britain, 1740–1950*, p. 139; Afton and Turner, 'Agricultural output', Table 38.11.

<sup>33</sup> Grigg, 'Farm size', p. 187.

<sup>34</sup> Grigg, 'Farm size'; Lawton and Pooley, *Britain, 1740–1950*; Shaw-Taylor, 'Agrarian capitalism'.



1881–1911.<sup>35</sup> However, I-CeM does not contain the census data for England and Wales for 1871, which has been derived here from other census transcriptions by S&N.<sup>36</sup> We refer to this as the I-CeM/S&N data, which is part of a ‘British Business Census of Entrepreneurs’ data deposit at UKDA.<sup>37</sup> The use and interpretation of these data requires detailed understanding of the census process.

The I-CeM/S&N data contain transcribed and coded individual census records. As part of their occupational information, in the four censuses, 1851–81, farmers were instructed to state the numbers of acres they occupied, and the number of people they employed on the farm at the time of the census. After 1881, however, the census question changed and no information on acres or workforce was collected, so we have to restrict our discussion to the four census years. The employer information was additional to workers being asked to identify themselves as agricultural labourers: the farmer listed as his occupation ‘farmer of X acres employing Y labourers’, while labourers were returned as ‘agricultural labourer’. The question was intended to record the regular formal workforce on Britain’s farms. The census administrators deliberately avoided holding the census during the harvesting season, meaning that farmers who returned a workforce were supposed to be reporting the number of those who were employed by them throughout the year. As noted above, the instruction also sought to exclude informal family labour unless fully employed, and even then they were to be described as ‘farmer’s son’ and ‘farmer’s daughter’ or ‘farmer’s wife’. This should have excluded spouses and children from the workforce listed by employers unless they were fully employed throughout the year.<sup>38</sup> Married couples generally returned the employer information under the household head, usually the husband. While the term ‘farmer’s wife’ could mean anything from business partner to a social indicator of marital status, it certainly included some women’s labour on the farm;<sup>39</sup> however, in the terms of the census instructions, only ‘regular’, non-seasonal work should have been included. Analysis of the census database now available can include or exclude these wives, sons and daughters, as desired by the researcher. More broadly, of the farmers who, as employers, returned the farms’ acres and employees, between 9 and 10 per cent were female; about three quarters of these were widows who had taken over the farm.

The terminology of the workforce instructions changed over time: in 1851 farmers were asked to simply return their labourers. The 1861 question read ‘men and boys employed on the farm’, and in 1871 and 1881 it changed to ‘men, women, and boys’. This was reflected in the farmers’ responses: 73 per cent of the workforce returned by farmers in 1851 were labourers,

<sup>35</sup> K. Schürer, E. Higgs, A. M. Reid and E. M. Garrett, *Integrated Census Microdata, 1851–1911, version V. 2 (I-CeM.2)* (2016).

<sup>36</sup> For 1871 data from S&N: The Genealogist is comparable to I-CeM and comes from the same Census Enumerator Books (CEBs). However, because of the way the S&N data had to be extracted, information on relationships within the household, such as the number of servants present, as well as marital status, is unavailable. In addition, the 1871 extractions have several geographically concentrated data gaps in S&N, resulting in the lower N of parishes in Tables 1 and 2.

This deficiency is corrected by weighting for national numbers in Figure 1, and weighting by data completeness at RD level in Tables 2 and 4. Further detail of data processing for 1871 is discussed in C. van Lieshout, J. Day, P. Monteburno, and R. J. Bennett, *Extraction of data on Entrepreneurs from the 1871 Census to supplement I-CeM* (2018), doi.org/10.17863/CAM.27488.

<sup>37</sup> Due for deposit in Mar.–Apr. 2019.

<sup>38</sup> BPP, 1854. Census of England and Wales for the year 1851, General Report, p. lxxviii.

<sup>39</sup> Higgs, ‘Occupational censuses’; Higgs, *Making sense*.

which dropped to 20 per cent in later years, as the majority of the workforce was described as men and boys. Women or girls were rare in the returned workforces: only 2 per cent of the reported workforce was explicitly female in 1851 and 1861, but this rose to 3–4 per cent in 1871 and 1881, reflecting the change in census question. This compares to 5–6 per cent of self-reported agricultural labourers being female in both I-CeM/S&N and the published census tables. While it is possible that the farmers underreported some of their female workforce, it is more likely that they were hidden under the gender-neutral ‘labourer’ descriptor. Because of this imprecise response in so many cases, attention is restricted here to the aggregate number of workforce returned; though future analysis could look at the gender and age of those listed.

While the vast majority of farmers answered the census question for employers to give their workforce, there are two indicators showing that not every farmer fully followed the instruction. First, there were farmers who returned acreages but no employees, but who were unlikely to have been able to farm without employing a workforce. Second, there is a discrepancy between the total workforce declared by employers, and the number of people who self-identified as agricultural labourers. For example, in 1881 farmers reported 614,028 employees while self-reported agricultural labourers numbered 737,026, 20 per cent more. For 1851 employer-reported workers were 592,696 and self-reported labourers 989,289 (67 per cent more). This has been a source of previous criticism of the published census tables.<sup>40</sup> However, much of this discrepancy arises because agricultural labourers were asked by the census to report their occupation even if retired or temporarily out of work (which was a large number because the census was taken at a low point for seasonal employment). The rest of the discrepancy was accounted for by a few employers who omitted to give their workforce. This number can, however, be estimated from the responses they did provide, as discussed below. This allows our data to be more complete than the published tables based on the same records. It is a surprising result that has not been previously noted, that checks between the actual census data (now in I-CeM/S&N) and the published census tables in 1851, 1861 and 1871 show that the Census General Reports missed some farm employers who listed their employees in the original records; moreover the proportion omitted increased the larger the size of the farm. This makes the I-CeM/S&N data in some respects superior in coverage to the published tables for larger farms, which until now formed the only available basis for farm size analysis.<sup>41</sup>

The detailed information on workforce and acreage provided in the occupational descriptor can be used to identify farmers as either employers or own account.<sup>42</sup> The new e-census data,

<sup>40</sup> D. R. Mills, ‘Trouble with farms at the Census Office: An evaluation of farm statistics from the censuses of 1851–1881 in England and Wales’, *AgHR* 47 (1999), pp. 58–77; M. Overton, *Agricultural revolution in England. The transformation of the agrarian economy, 1500–1850* (1996); see for a partial rebuttal, L. Shaw-Taylor, ‘Family farms and capitalist farms in mid nineteenth-century England’, *AgHR* 53 (2005), p. 164.

<sup>41</sup> See C. Van Lieshout and R. J. Bennett, ‘Extracted data on employers and farmers compared with published tables in the Census General Reports, 1851–1881’ (working paper, 2019) ([doi.org/10.17863/CAM.37165](https://doi.org/10.17863/CAM.37165)),

Tables 2 and 3 for the 1851 GRO complete county coverage; Tables 5 for 1861 GRO 10 sample counties; and Table 7 and 8 for 1871 GRO ‘representative’ counties.

<sup>42</sup> The detailed methodology required to extract the employer and own account information is discussed in working papers by the authors, in particular C. Van Lieshout, R. J. Bennett, H. Smith, G. Newton, ‘Identifying businesses and entrepreneurs in the Censuses, 1851–1881’ (2017), [doi.org/10.17863/CAM.9639](https://doi.org/10.17863/CAM.9639); and R. J. Bennett, P. Montebruno, H. Smith, and C. van Lieshout, ‘Reconstructing entrepreneurship and business numbers for censuses, 1851–81’ (2018), available at

when processed, provide a unique and comprehensive source for all farms for this period. This overcomes the two main deficiencies of most previous analyses of early British farming: first, that the data previously available (from the *Agricultural Statistics*) was only for holdings, which are often multiple, not farms; and second, that these are available only from 1866 when, as noted above, many changes were already established.<sup>43</sup> It also allows some of the claims about the supposed inaccuracy of census returns to be refuted, though, as shown below, careful treatment of the data is required.<sup>44</sup>

The information on the status of farm entrepreneurs given in the census data allows differentiation of employers (E) who employ a workforce, from own account (OA) who employ no one else. The demographics of each agricultural entrepreneur are also recorded: age, sex, marital status, relationship with others in the household, their number of domestic servants, and their location. The data also give the quantity of labour, if any, reported by each farmer and the number of acres farmed (excluding wasteland and rough grazing).<sup>45</sup> The summary statistics for all farmers in England and Wales 1851–81 are shown in Table 2 at parish level. The number of parishes containing enough farmers to provide reliable summary statistics varies by year, with 1871 indicating the smaller set available in the S&N data. The total number of parishes in existence reduced from 16,395 to 15,297 over 1851–81 as a result of boundary changes, so that Table 2 indicates that between 88 per cent and 93 per cent of parishes contained farmers (with 79 per cent available in 1871).

Relationships between individuals within the same household (RELA) are coded into nine categories. The census records relationship with respect to the ‘head’ of the household responsible for making the census return. Other members of their family (conjugal family unit [CFU] of spouse, sons and daughters), are distinguished here from older generations (parents, uncles and aunts), siblings of the head, other family relatives (grandparents, cousins, nephews, nieces), household domestic servants, co-resident farm workers, lodgers, and finally any other non-household people who were visiting at the time of the census.<sup>46</sup> Land quality is measured in five categories defined by the modern typology of Agricultural Land Classification (ALC).<sup>47</sup> This has been projected backwards to the period of study by using the 1930s land use survey and adjusted for earlier changes of forest cover, reservoirs and urban development.<sup>48</sup> Land is graded on a five-point scale, with Grade 5 (the worst) used as a base category to allow estimation of the model. Other variables included control for gender, marital status, and locational variables measuring distance to nearest market town, distance to nearest rail line, latitude and longitude.

Note 42 *continued*

[www.geog.cam.ac.uk/research/projects/driversofentrepreneurship/wp9reconstruction.pdf](http://www.geog.cam.ac.uk/research/projects/driversofentrepreneurship/wp9reconstruction.pdf)

<sup>43</sup> See J. Ashton and B. E. Cracknell, ‘Agricultural holdings and farm business structure in England and Wales’, *J. Agricultural Economics*, 14 (1961), pp. 472–506; Grigg, ‘Farm size’; Grigg, *English agriculture*.

<sup>44</sup> Mills, ‘Trouble with farms at the Census Office’.

<sup>45</sup> Higgs, *Making sense*.

<sup>46</sup> This is a simplification of the of RELA codes in I-CeM: see E. Higgs, C. Jones, K. Schürer and

A. Wilkinson, *Integrated Census Microdata (I-CeM) Guide* (sec. edn, 2015).

<sup>47</sup> Ministry of Agriculture Fisheries and Food, *Agricultural land classification of England and Wales* (1988).

<sup>48</sup> K. J. Taylor, N. Walford, and B. Short, ‘Assessing the land use of interwar Britain: A comparison of the First Land Utilisation Survey field sheets and 1:63,360 scale maps’, *Applied Geography*, 30 (2010), pp. 50–62. These data have been prepared by Max Satchell with the detailed methods to be reported in a forthcoming Working Paper.

TABLE 2. Summary Statistics: means at parish level 1851–81; 1871 raw data, unweighted.

| <i>Variable</i>               | <i>1851</i> |                  |             |             | <i>1861</i> |                  |             |             |
|-------------------------------|-------------|------------------|-------------|-------------|-------------|------------------|-------------|-------------|
|                               | <i>Mean</i> | <i>Std. Dev.</i> | <i>Min.</i> | <i>Max.</i> | <i>Mean</i> | <i>Std. Dev.</i> | <i>Min.</i> | <i>Max.</i> |
| ParID                         | 8,420       | 4,639            | 3           | 16,397      | 8,250       | 4,579            | 3           | 16,194      |
| Ees [prob of being employer]  | 0.587       | 0.322            | 0           | 1           | 0.544       | 0.324            | 0           | 1           |
| Total Employees               | 40.096      | 60.909           | 0           | 4078        | 39.618      | 47.66            | 0           | 1186        |
| Acreage                       | 1,417.42    | 1,944.78         | 0           | 88,303      | 1,359.79    | 1,362.37         | 0           | 15,754      |
| E [Employers]                 | 10.299      | 12.195           | 0           | 204         | 9.567       | 11.217           | 0           | 166         |
| OA [Own accounts]             | 3.008       | 8.263            | 0           | 162         | 2.75        | 9.19             | 0           | 182         |
| Log E/OA                      | 1.329       | 1.202            | −4.997      | 4.852       | 1.428       | 1.169            | −4.5        | 4.963       |
| Agricultural workers reported | 2.445       | 6.302            | 0           | 139         | 2.539       | 5.352            | 0           | 124         |
| Sex Male (proportion)         | 0.908       | 0.124            | 0           | 1           | 0.908       | 0.123            | 0           | 1           |
| Age                           | 49.600      | 6.470            | 16          | 88          | 49.587      | 6.689            | 14          | 89          |
| Servants (domestic)           | 1.749       | 1.200            | 0           | 10          | 1.606       | 1.134            | 0           | 10          |
| RELA Head                     | 0.929       | 0.131            | 0           | 1           | 0.924       | 0.131            | 0           | 1           |
| RELA CFU member               | 0.033       | 0.084            | 0           | 1           | 0.039       | 0.089            | 0           | 1           |
| RELA Older generation         | 0.002       | 0.022            | 0           | 1           | 0.003       | 0.023            | 0           | 1           |
| RELA Siblings                 | 0.011       | 0.043            | 0           | 0.667       | 0.012       | 0.044            | 0           | 1           |
| RELA Other Family             | 0.004       | 0.022            | 0           | 0.5         | 0.004       | 0.024            | 0           | 1           |
| RELA Servants                 | 0.001       | 0.016            | 0           | 0.5         | 0.002       | 0.025            | 0           | 1           |
| RELA Working Title            | 0.000       | 0.013            | 0           | 1           | 0.          | 0.006            | 0           | 0.429       |
| RELA Lodgers/Boarders         | 0.004       | 0.032            | 0           | 1           | 0.006       | 0.039            | 0           | 1           |
| RELA Non-household            | 0.001       | 0.025            | 0           | 1           | 0.002       | 0.032            | 0           | 1           |
| Marital status Single         | 0.156       | 0.170            | 0           | 1           | 0.151       | 0.171            | 0           | 1           |
| Marital status Married        | 0.696       | 0.207            | 0           | 1           | 0.704       | 0.21             | 0           | 1           |
| Agricultural land, Grade 1    | 2.669       | 10.991           | 0           | 100         | 2.649       | 10.921           | 0           | 100         |
| Agricultural land, Grade 2    | 16.374      | 23.939           | 0           | 100         | 16.723      | 24.292           | 0           | 100         |
| Agricultural land, Grade 3    | 60.570      | 31.942           | 0           | 100         | 60.462      | 31.982           | 0           | 100         |
| Agricultural land, Grade 4    | 14.863      | 21.793           | 0           | 100         | 14.697      | 21.631           | 0           | 100         |
| Agricultural land, Grade 5    | 5.525       | 16.101           | 0           | 100         | 5.469       | 16.029           | 0           | 100         |
| Distance to Town Centre       | 2,448.04    | 3,279.24         | 0           | 25,088.74   | 2,421.55    | 3,216.734        | 0           | 25,088.74   |
| Latitude                      | 52.549      | 1.194            | 50.033      | 55.76       | 52.557      | 1.198            | 50.033      | 55.764      |
| Longitude                     | −1.532      | 1.492            | −5.647      | 1.732       | −1.511      | 1.48             | −5.647      | 1.732       |
| Distance to rail line         | 8,738.44    | 10,430.106       | 1.113       | 71,848.25   | 4,747.14    | 4,827.39         | 0.038       | 47,234.16   |
| No of parishes                | 14,370      |                  |             |             | 14,875      |                  |             |             |

Source: Authors' calculations from I-CeM/S&N data.

| <i>Variable</i>               | <i>1871</i> |                  |             |             | <i>1881</i> |                  |             |             |
|-------------------------------|-------------|------------------|-------------|-------------|-------------|------------------|-------------|-------------|
|                               | <i>Mean</i> | <i>Std. Dev.</i> | <i>Min.</i> | <i>Max.</i> | <i>Mean</i> | <i>Std. Dev.</i> | <i>Min.</i> | <i>Max.</i> |
| ParID                         | 8,162       | 4,515            | 2           | 16,028      | 7,805       | 4,343            | 3           | 15,297      |
| Ees [prob of being employer]  | 0.572       | 0.362            | 0           | 1           | 0.529       | 0.32             | 0           | 1           |
| Total Employees               | 37.147      | 46.197           | 0           | 961         | 42.343      | 99.244           | 0           | 5490        |
| Acreage                       | 1,575.12    | 1,749.16         | 0           | 80,000      | 1,520.55    | 1,559.43         | 0           | 18,553.8    |
| E [Employers]                 | 8.709       | 10.283           | 0           | 155         | 8.833       | 10.116           | 0           | 154         |
| OA [Own accounts]             | 4.681       | 12.364           | 0           | 233         | 4.244       | 12.098           | 0           | 195         |
| Log E/OA                      | 1.062       | 1.486            | -5.136      | 5.05        | 1.198       | 1.207            | -4.41       | 5.043       |
| Agricultural workers reported | 0.018       | 0.165            | 0           | 6           | 2.483       | 4.949            | 0           | 98          |
| Sex Male (proportion)         | 0.902       | 0.142            | 0           | 1           | 0.915       | 0.122            | 0           | 1           |
| Age                           | 50.375      | 7.001            | 17          | 94          | 49.901      | 6.61             | 17.5        | 89          |
| Servants (domestic)           | NA          | NA               | NA          | NA          | 1.276       | 1.016            | 0           | 16          |
| RELA Head                     | 0.957       | 0.113            | 0           | 1           | 0.931       | 0.117            | 0           | 1           |
| RELA CFU member               | 0.024       | 0.08             | 0           | 1           | 0.034       | 0.079            | 0           | 1           |
| RELA Older generation         | 0.002       | 0.028            | 0           | 1           | 0.003       | 0.026            | 0           | 1           |
| RELA Siblings                 | 0.007       | 0.043            | 0           | 1           | 0.013       | 0.045            | 0           | 1           |
| RELA Other Family             | 0.001       | 0.016            | 0           | 0.5         | 0.003       | 0.023            | 0           | 1           |
| RELA Servants                 | 0.002       | 0.026            | 0           | 1           | 0.001       | 0.013            | 0           | 0.5         |
| RELA Working Title            | 0.001       | 0.017            | 0           | 1           | 0           | 0.007            | 0           | 0.333       |
| RELA Lodgers/Boarders         | 0.002       | 0.028            | 0           | 1           | 0.005       | 0.037            | 0           | 1           |
| RELA Non-household            | 0           | 0.009            | 0           | 1           | 0.002       | 0.034            | 0           | 1           |
| Marital status Single         | NA          | NA               | NA          | NA          | 0.149       | 0.17             | 0           | 1           |
| Marital status Married        | NA          | NA               | NA          | NA          | 0.708       | 0.211            | 0           | 1           |
| Agricultural land, Grade 1    | 2.852       | 11.373           | 0           | 100         | 2.652       | 10.898           | 0           | 100         |
| Agricultural land, Grade 2    | 17.591      | 24.814           | 0           | 100         | 16.844      | 24.481           | 0           | 100         |
| Agricultural land, Grade 3    | 59.977      | 31.893           | 0           | 100         | 60.698      | 31.981           | 0           | 100         |
| Agricultural land, Grade 4    | 14.262      | 21.368           | 0           | 100         | 14.523      | 21.561           | 0           | 100         |
| Agricultural land, Grade 5    | 5.318       | 15.745           | 0           | 100         | 5.284       | 15.71            | 0           | 100         |
| Distance to Town Centre       | 2,460.12    | 3,411.94         | 0           | 54716.09    | 2,403.78    | 3,207.98         | 0           | 25088.74    |
| Latitude                      | 52.544      | 1.169            | 49.934      | 55.764      | 52.538      | 1.191            | 50.0        | 55.764      |
| Longitude                     | -1.47       | 1.512            | -6.314      | 1.732       | -1.5        | 1.493            | -5.64       | 1.732       |
| Distance to rail line         | 3,483.635   | 3,558.356        | 0.038       | 59475.54    | 2,917.68    | 2,740.42         | 0.03        | 59,475.5    |
| No of parishes                | 12,666      |                  |             |             | 14,287      |                  |             |             |

A significant census defect, already alluded to, was that it was possible for some farmers to respond to the census question without specifying their workforce, despite reporting a farm acreage that must have required the employment of labour. This non-response bias has previously been considered a critical defect of the census, but this can now be corrected using the I-CeM/S&N individual census records.<sup>49</sup> First, many small farmers who did not respond to the employer question were smallholders who had another occupation (often as labourers) and only a small acreage of farmland.<sup>50</sup> These can be identified from the census returns and excluded. (We exclude from most of the analysis and discussion all farmers who returned under five acres. This is line with many other analyses of farms that truncate data to exclude the smallest operators as not relevant to farming as an industry.<sup>51</sup>) Second, we can make use of the extra information in the farm question of acres. All farmers of any significance appear to have answered the question on acreage even when they reported no employees. This can be used to estimate the number of non-respondent employers to compensate for the non-response bias. This uses a logit regression to estimate the probability of reporting employees based on the acreage of each farmer's farm and their employees for those farms that returned both data. This estimate is then applied to those farmers who only reported acres, to distinguish those that were most probably employers from those that were own account. This is based on the simplest and most parsimonious model, but with estimation for each of 623–630 Registration Districts (RDs) separately, so that differences between the employer/own account ratios for a given acreage takes account of the main locational differences in farming.<sup>52</sup> The method of calculation is explained further in the Appendix. Although this is an important adjustment, it should be noted that the majority of the data derives from the original employer descriptions; the proportion of farm employers adjusted was 25.7 per cent in 1851, 20.95 per cent in 1861, 22.2 per cent in 1871, and 16.2 per cent in 1881.

After these adjustments the full data can be used to give an overview of the geographical patterns of farm entrepreneurship. We use the acreage that marks the median point of cut-off between employer and own-account status as a means to indicate how the pattern of entrepreneurship varies for each RD (calculated as described in the Appendix). As shown in Figures 2a–2d for each year, there is an evolution between the census years. In 1851 the area covered by farms with low average cut-offs (i.e. areas where a small acreage was sufficient to support employers) was much greater than in subsequent years, with a severe decrease in area of employer-run farms by 1881. The change was initially slow over 1851–61, and was greatest over 1861–71, now evidencing the geographical variations in the general trend shown in Figure 1. Conversely, the areas with high cut-offs, associated with primarily own-account farms, expanded from what were chiefly upland areas with poorer land in 1851. This reflected a persistence of family farms in these areas that has been noted from earlier periods.<sup>53</sup> But by 1881 high cut-offs covered a much wider northern area, much of which had good quality land. Small farms, of 50 acres or fewer, that nevertheless employed people became mainly restricted

<sup>49</sup> Mills, 'Trouble with farms at the Census Office'.

<sup>50</sup> Higgs, *Making sense*; Grigg, 'Farm size'; Mills, 'Trouble with farms at the Census Office'.

<sup>51</sup> P. Allanson, 'Farm size structure in England and Wales, 1939–89', *J. Agricultural Economics* 43 (1992),

pp. 137–48.

<sup>52</sup> There were 623 RDs in 1851 and 1861, 626 in 1871 and 630 in 1881.

<sup>53</sup> Shaw-Taylor, 'Agrarian capitalism', pp. 49–56.



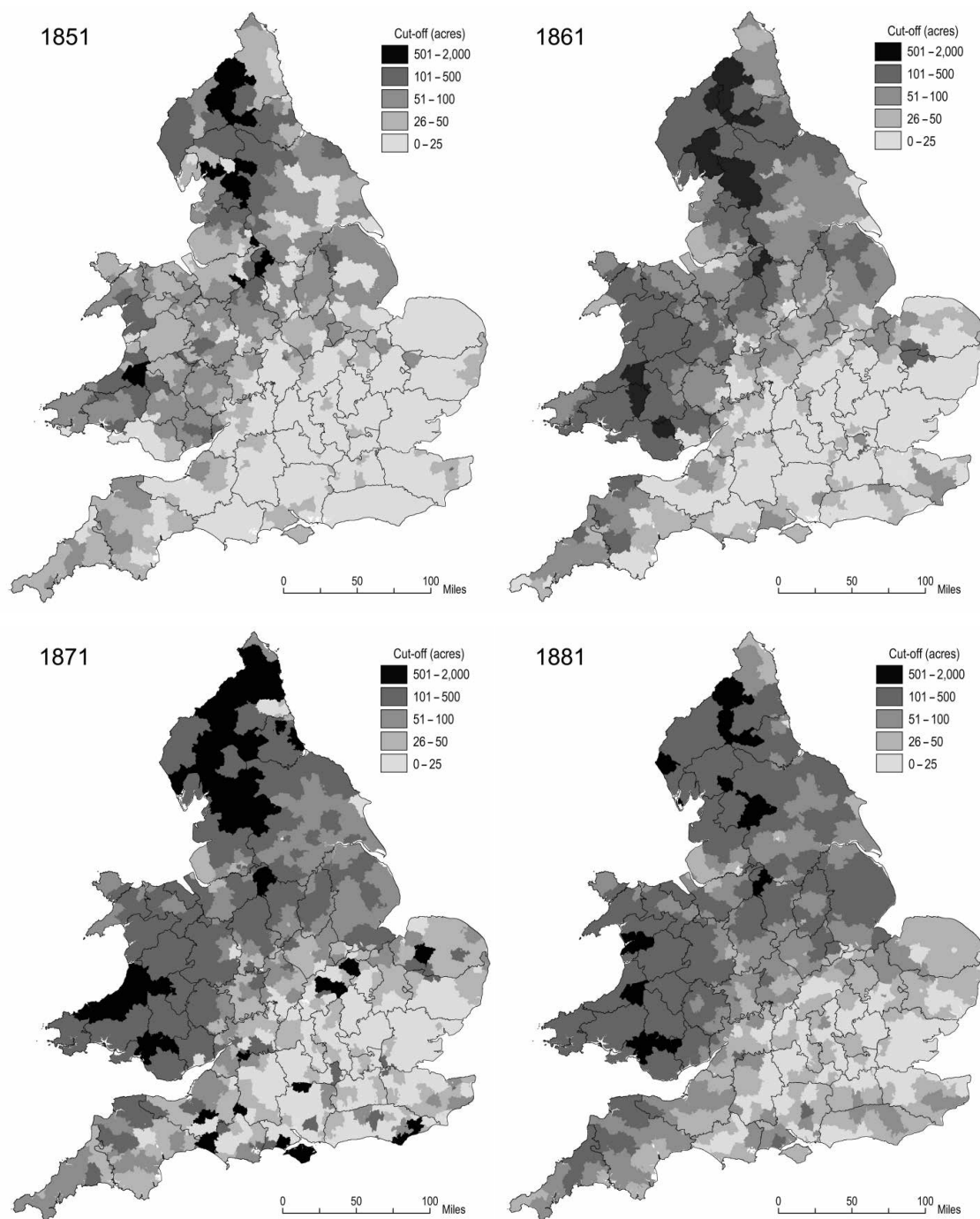


FIGURE 2a-d. Geographical distribution of cut-off (average size in acres) above which farmers were more likely to be employers than own account for each Registration District 1851-81.

Source: Authors' calculations from I-CeM/S&N data.

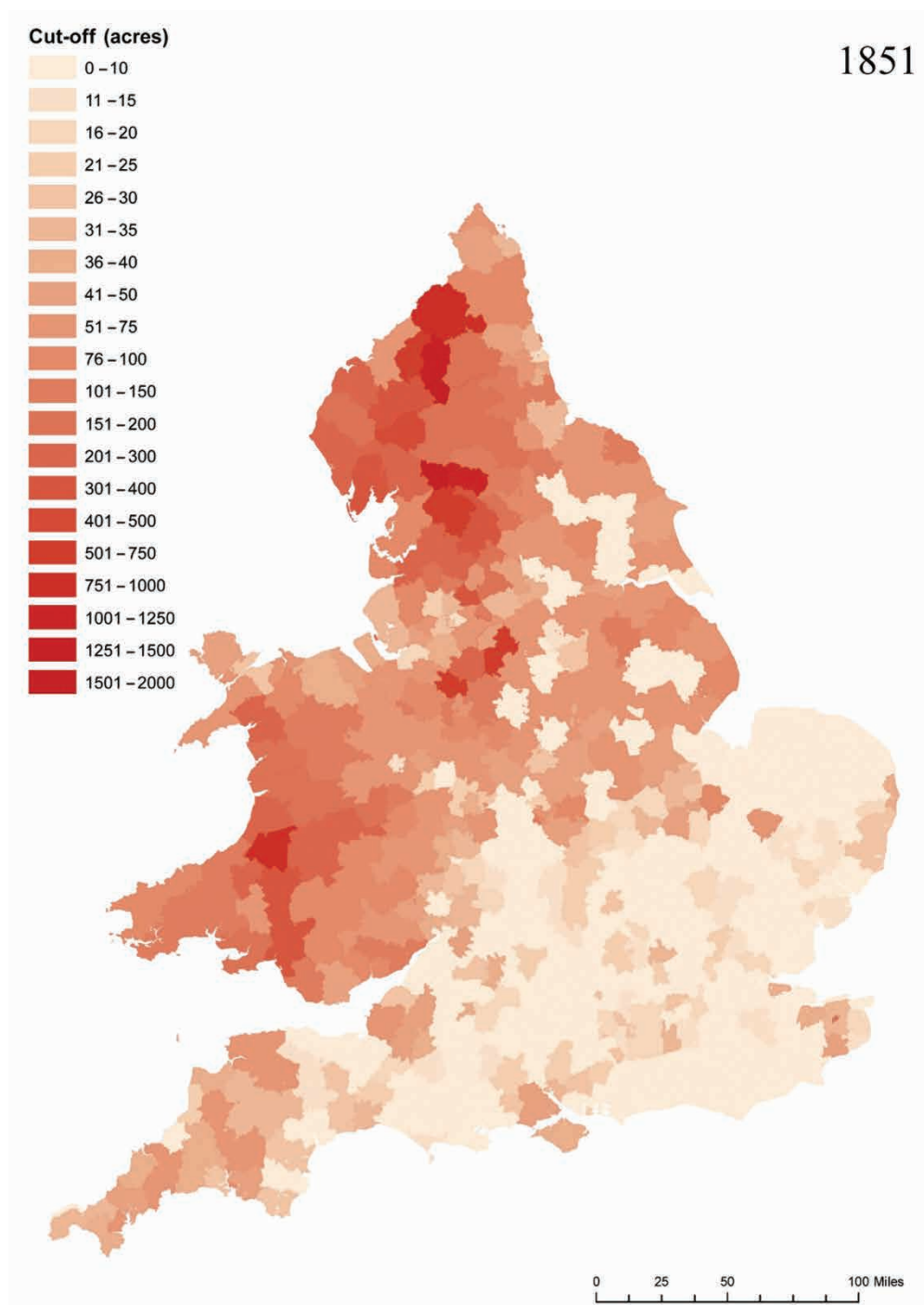


FIGURE 2a. Geographical distribution of cut-off (average size in acres) above which farmers were more likely to be employers than own account for each Registration District 1851.

Source: Authors' calculations from I-CeM/S&N data.

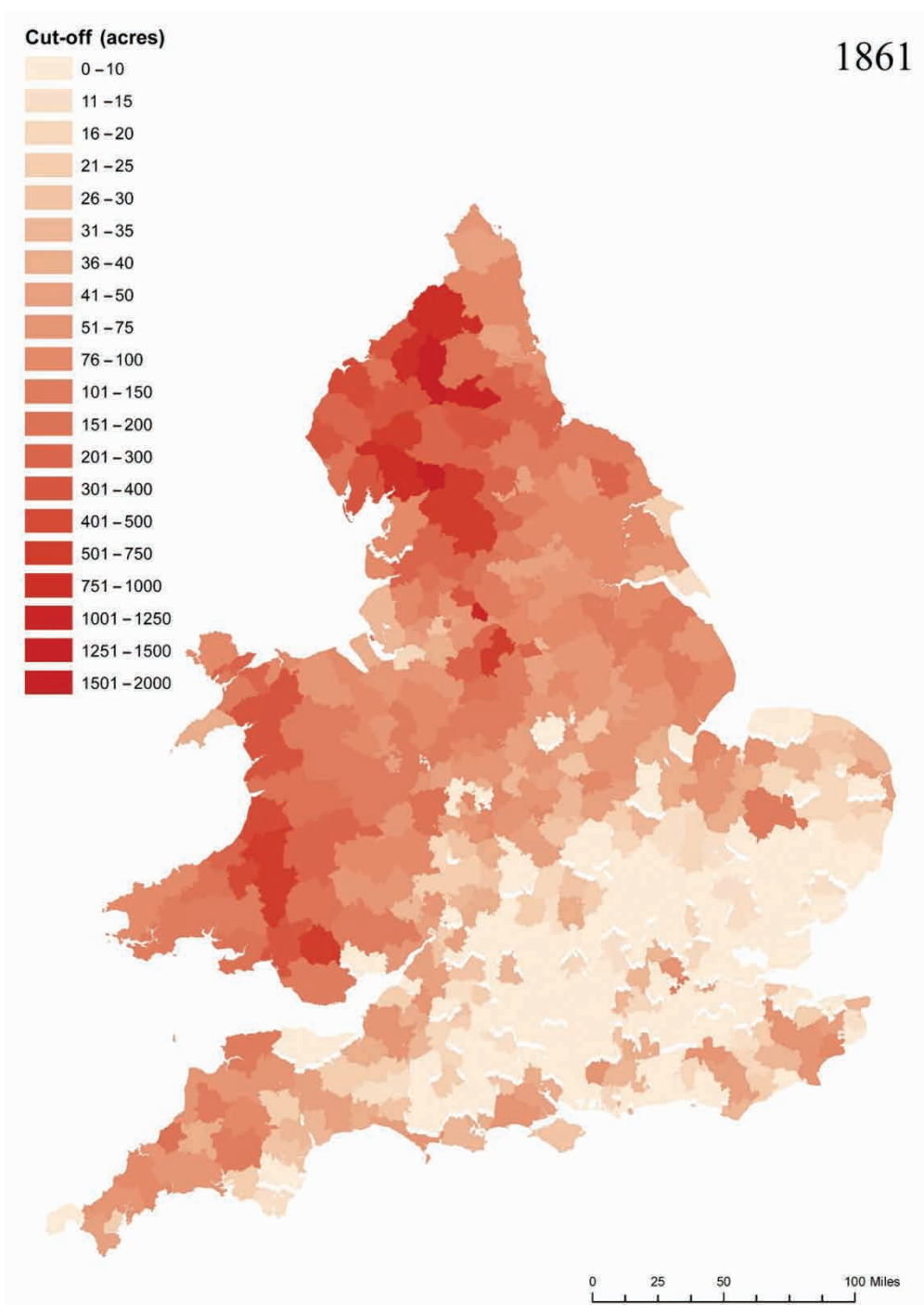


FIGURE 2b. Geographical distribution of cut-off (average size in acres) above which farmers were more likely to be employers than own account for each Registration District 1861.

Source: Authors' calculations from I-CeM/S&N data.

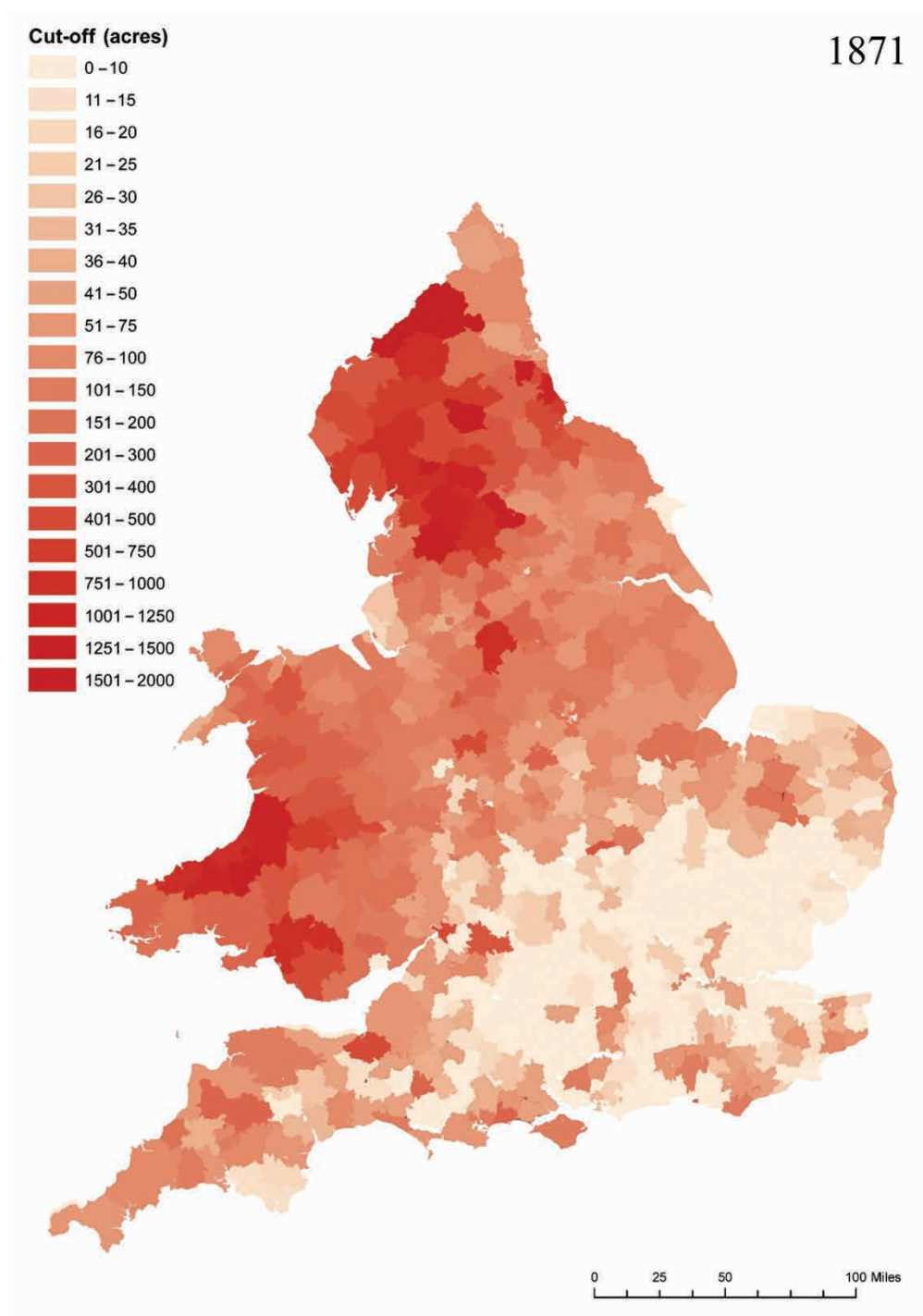


FIGURE 2C. Geographical distribution of cut-off (average size in acres) above which farmers were more likely to be employers than own account for each Registration District 1871.

Source: Authors' calculations from I-CeM/S&N data.

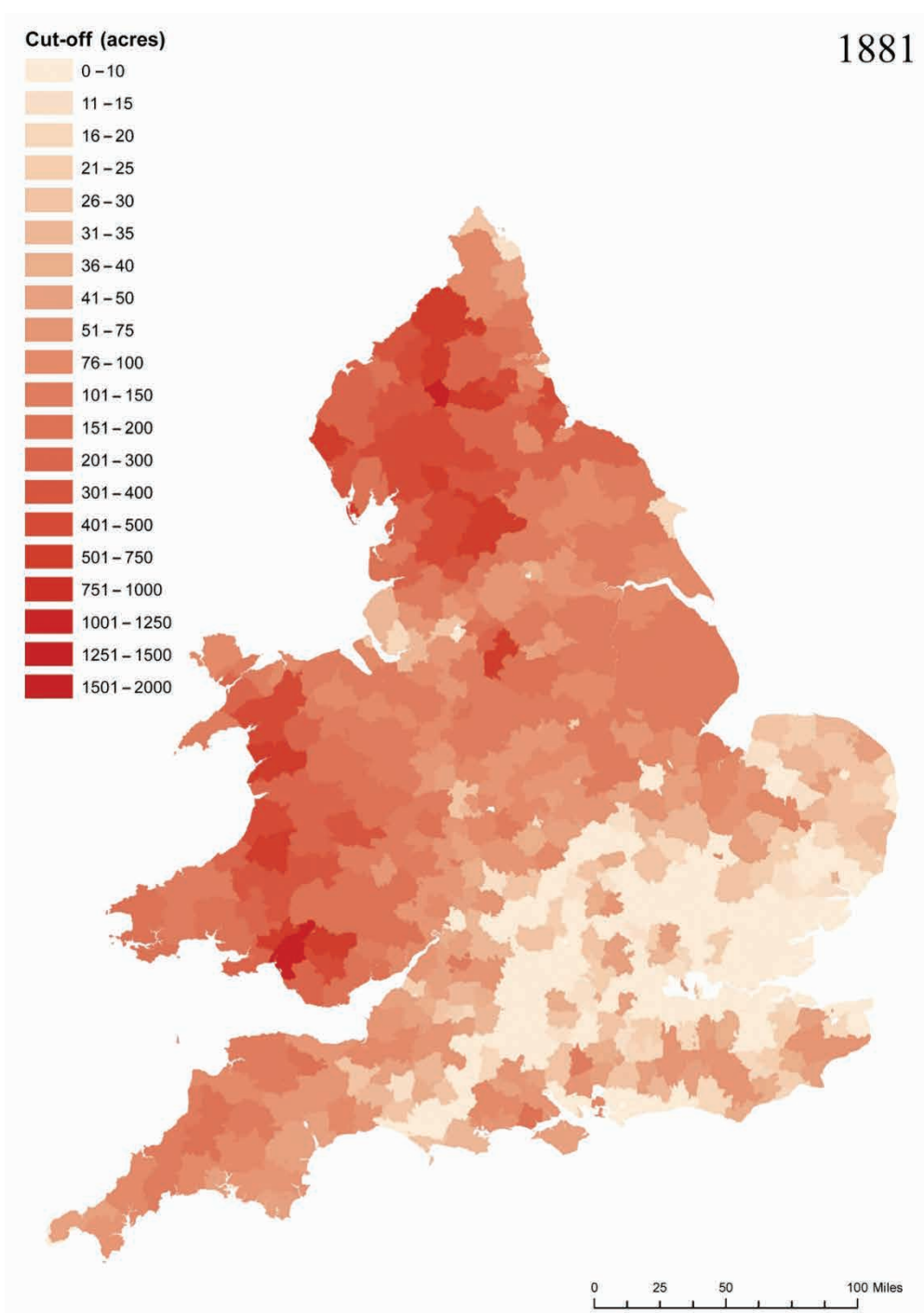


FIGURE 2d. Geographical distribution of cut-off (average size in acres) above which farmers were more likely to be employers than own account for each Registration District 1881.

Source: Authors' calculations from I-CeM/S&N data.



to an area around London and the south east, and to lesser extent the areas around the major urban centres in the Midlands, the north west, and west Yorkshire.

The mapping of the geographical pattern provides insights for the first time, at a national scale, based on farms as the entrepreneurial units rather than holdings, and for the whole period 1851–81. In the north, south west and Wales, farmers reduced their workforce. The high cut-off areas in 1851, in upland locations, expanded by 1881 to include nearly all counties above the line running from the Severn to the Wash. The change in Wales is particularly noticeable. The south and east of the country were, in contrast, characterized by fairly stable cut-offs, which rose slightly between 1851 and 1881. While a significant switch from arable to pasture in the south and east probably accounts for the stability of this region,<sup>54</sup> this did not result in any reduced probability of being an employer because the market for their produce (mainly meat, milk and dairy) remained buoyant. The figures suggest contrasted entrepreneurial responses between regions: with farm employers mostly able to maintain workforces and outputs in the south and east, where the ratio of employers to own account even increased to a small extent, whilst in the north and west farmers generally switched to own-account farming or cut their employees so that the ratio of employers to own account significantly decreased. This adjustment may have been more likely since the north and west traditionally tended to have more family farms and thus found it easier to revert to a less labour-intensive form of farming.<sup>55</sup> However, while farmers in the south and east were more likely to maintain their status as employers, they also tended to reduce the number of workers they employed. In Sussex, for instance, farmers employed on average 8.7 workers in 1871, but only 8.1 by 1881, while farmers in Surrey contracted their average workforce from 8.1 to 7.4 over the same period. These data confirm existing accounts of the basic geography of the agricultural depression, but they also allow more nuanced interpretation. For example, while much of Lancashire followed the general pattern of the north, west Lancashire maintained relatively low cut-off acreages throughout the period, reflecting the contrast between the arable west of the county and the pastoral east.<sup>56</sup> Yorkshire also exhibited significant internal variation, with the area around Leeds and other wool-producing urban centres being characterized by employers with relatively small farms, a pattern also seen on the east coast from Bridlington south and a central part of the North Riding. Much of the rest of the north of the West and North Ridings were characterized by high cut-offs, as was much of the East Riding. These local variations indicate important complexity not visible in previous analyses, which should open the door to more research to explain the sub-regional variation in how farmers responded to the pressures of the 1870s and 1880s.

The maps indicate some of the additional factors, which we examine below in more detail using parishes, such as land quality, urban and transport access. Close to urban areas the cut-off between employer and own account average acreages was lower, while in areas of predominantly upland and rough grazing the cut-off was much higher. Clearly farmers' adjustments to their entrepreneurial status depended on location, land quality, and other factors. This was in addition to adaptations in farm practices and technical change noted in the earlier historiography. As agricultural production became increasingly capital-intensive, more single entrepreneurs

<sup>54</sup> Collins, 'Rural and agricultural change', p. 150.

<sup>55</sup> Shaw-Taylor, 'Agrarian capitalism', p. 57.

<sup>56</sup> T. W. Fletcher, 'Lancashire livestock farming during the Great Depression', *AgHR* 9 (1961), pp. 18–20.



operating on their own account could manage their farm alone. Employer-status farmers became increasingly concentrated on very large farms, on those with better land, or those that were favourably located, mainly by adjusting to meet urban demands through shifts of agricultural output from grain and arable crops to dairying and meat production as observed by contemporaries.<sup>57</sup> But it can now be seen unambiguously that these changes chiefly occurred on farms close to London or other urban centres where changes in consumer preferences had most impact.

### III

We next investigate the factors underlying the geographical patterns in Figure 2 statistically, and also control for the effects of household structure, gender, and marital status using the census information. We initially make cross-sectional estimates of the influence of different factors on entrepreneurial decisions. We use the dependent variable, Log E/OA:

$$\log \frac{E + 1}{OA + 1}$$

This defines the ratio of the number of employers (E) to own account (OA) for each geographical location. The addition of one in the numerator and denominator is a standard manipulation to remove zeros to allow model convergence and ensure calculations are always feasible. The estimates are for geographical units and not the individual farms. We are interested in how individual choice probabilities between employer or own account were influenced by different local and personal factors.

The ratio is positive if there are more employers than own account in a location, and negative if there are more own account than employers. Consequently, this dependent variable is analogous to a log-likelihood ratio. As well as the ratio of the number of employers and own account it is also the ratio of the percentage of employers and the percentage of own account in a geographical unit, as proved by:

$$\begin{aligned} \log \frac{E + 1}{OA + 1} &= \\ &= \log \left( \frac{E + 1 \text{ \#Farms}}{OA + 1 \text{ \#Farms}} \right) = \\ &= \log \frac{\frac{E + 1}{\text{\#Farms}}}{\frac{OA + 1}{\text{\#Farms}}} = \end{aligned}$$

<sup>57</sup> Graham, *Revival*.

$$\log \frac{\sim perc E}{\sim perc OA}$$

Consequently, the estimates permit us to explore the probability between the employer and own-account entrepreneurship in a given location, while controlling for other inputs. The model is:

$$\log \frac{E + 1}{OA + 1} = \beta_A A + \beta_L L + \beta_K K + \beta_T T + \beta_Y Y$$

The logarithm allows the calculation of the semi-elasticity of substitution between employer and own-account entrepreneurship in a given place after controlling for other factors.

This model of entrepreneurial change derives from a standard production function of the marketed surplus (profit) from agriculture. This is the earnings in excess of payment to all the factors of production, excluding entrepreneurship. The economic activity of a farm depends on combining different inputs to produce agricultural products.<sup>58</sup> These inputs vary from labour (L, skilled or unskilled labour), capital (K, machines, tools, buildings, chemicals, fertilizers), land (A, both quality and quantity measured in acres), access to markets (T, transport as distance or access to main agricultural markets or points of transport access, such as railways) and management/entrepreneurship (ENT, the degree of entrepreneurship, as employers E, or as own account OA):

$$Y = f(L, K, A, T, ENT)$$

Thus, farm entrepreneurship is measured by the capacity of management to combine factors. Profits are the payment to the entrepreneur as coordinator, arbitrageur, innovator, and uncertainty-bearer.<sup>59</sup> But the key aspect – first discussed by Cantillon for the eighteenth century – is bearing the uncertainty of fluctuating demand and weather conditions, which ‘hired factors’ do not share as they receive payments whatever the profit (provided the farm remains in business). In Cantillon’s words: ‘The price of the Farmer’s produce depends naturally upon these unforeseen circumstances, and consequently he conducts the enterprise at an uncertainty’.<sup>60</sup>

The equation for entrepreneurship is equivalent to an expansion of the standard production function:

$$\bar{Y} = f(E, OA \mid A, L, K, T)$$

To the left of the vertical bar of conditionality, there are the two variables of employer and own account entrepreneurship at a location. To the right, the other inputs which are held constant

<sup>58</sup> A. Barkley and P. W. Barkley, *Principles of agricultural economics* (2013); D. Colman and T. Young, *Principles of agricultural economics: Markets and prices in less developed countries* (1989); J. Boyle, *Agricultural economics* (third edn, 1928).

<sup>59</sup> H. Barreto, *The entrepreneur in microeconomic theory: Disappearance and explanation* (1989).

<sup>60</sup> R. Cantillon, *Essai sur la Nature du Commerce en Général*, trans. and ed. by Henry Higgs (1731), p. 63.

and are not available for our estimates: the bar over the output indicates that the output is fixed. In this simplification we have to assume, in the absence of any available detailed other data, that E and OA are the only variables that vary by location and thus there is a direct measurement of the substitutability of the two forms of entrepreneurship. The model could be extended in future if other data become available.

The estimates use individual-level data aggregated within the smallest available geographical unit, the parish. This allows a highly sensitive assessment of the geography of farm entrepreneurship at a level of detail not previously possible. In the rural areas of England and Wales, where most farms are located, a parish corresponds to a village, group of hamlets, or small town, so that the units used generally correspond to functional communities. We first develop a sequence of cross-sectional parish estimates. Table 3 shows the results for the estimates of Log E/OA. For 1871, as noted earlier, because the census transcripts are derived from S&N, marital status and servant variables were not available. Also, because of some data gaps, 1871 estimates are weighted to align their coverage with the other years.

The two main causal variables estimated are the inputs of Total Employees (the sum of total employees declared by all farmers in the parish) and Acreages (the sum of total farm acreages in the parish). Both have both positive and highly significant coefficients: the expected signs. The coefficients for Acreages and Total Employees first increased over time, and then decreased. This pattern neatly aligns with the timing of the 'Golden Age' and ensuing challenges. Stable employer numbers 1851–61 reflected growth in markets driven by population growth and improving living standards.<sup>61</sup> But growth had slowed by the early 1860s, so that by the 1871 census the likelihood of being an employer had reduced at a given acreage, and own account increased. By 1881 the coefficient for the number of employees had decreased, indicating the reducing probability of employers in a parish even as the number of employees increased; i.e. average farm workforce sizes increased for those that were employers. Conversely, the small increases in size of the acreage coefficient indicates that being an employer became only slightly more likely as average farm acreages increased; this reflects the rigidities in the agricultural land market and restrictions of agricultural tenancy,<sup>62</sup> which results in relative stability of the acreage coefficients.

The estimates include a group of controls, which all have the expected signs. Age increased the employer/own-account entrepreneurship ratio at first positively, but then at older age decreased as the negative second order term takes effect. This age effect has been generally observed in other empirical studies and occurs across most industry sectors in the rest of the I-CeM/S&N data 1851–81.<sup>63</sup> Also, the estimates indicate that, as already known from the published census occupational tables, men were more frequently farmers than women, but we can now see that men were significantly more likely to be employers and to have larger farms and workforce. The

<sup>61</sup> Prothero, *English Farming*, p. 374.

<sup>62</sup> Grigg, 'Farm size', pp. 182–4; Collins, 'Rural and agricultural change', pp. 179–83.

<sup>63</sup> E.g. S. McNally, 'Farm diversification in England and Wales – what can we learn from the farm business survey?' *J. Rural Studies* 17 (2001), pp. 247–57; L. Rønning and L. Kovereid, 'Income diversification in

Norwegian farm households: Reassessing pluriactivity', *International Small Business J.* 24 (2006), pp. 405–20; R. J. Bennett, H. Smith, C. van Lieshout, P. Monteburno and G. Newton, *The age of entrepreneurship: Business proprietors, self-employment and corporations since 1851* (2019), ch. 6.

TABLE 3. Estimation of cross-sections, 1851–81

|                              | (1)                     |          | (2)                     |          | (3)                    |         | (4)                      |          |
|------------------------------|-------------------------|----------|-------------------------|----------|------------------------|---------|--------------------------|----------|
| <i>Independent variables</i> | <i>1851</i>             |          | <i>1861</i>             |          | <i>1871</i>            |         | <i>1881</i>              |          |
| Total Employees              | 0.00418 <sup>‡</sup>    | (2.69)   | 0.00648 <sup>‡</sup>    | (6.79)   | 0.00423 <sup>‡</sup>   | (2.66)  | 0.00156 <sup>‡</sup>     | (3.52)   |
| Acreage                      | 0.0001000 <sup>‡</sup>  | (2.94)   | 0.000118 <sup>‡</sup>   | (4.88)   | 0.000107 <sup>‡</sup>  | (2.93)  | 0.000114 <sup>‡</sup>    | (9.86)   |
| Age                          | 0.109 <sup>‡</sup>      | (9.47)   | 0.118 <sup>‡</sup>      | (18.40)  | 0.105 <sup>‡</sup>     | (6.53)  | 0.107 <sup>‡</sup>       | (12.58)  |
| Age # Age                    | −0.00107 <sup>‡</sup>   | (−9.19)  | −0.00118 <sup>‡</sup>   | (−17.91) | −0.00105 <sup>‡</sup>  | (−7.03) | −0.00109 <sup>‡</sup>    | (−12.59) |
| Sex Male                     | 0.389 <sup>‡</sup>      | (5.90)   | 0.146 <sup>†</sup>      | (2.56)   | −0.00425               | (−0.25) | 0.462 <sup>‡</sup>       | (6.88)   |
| Servants                     | 0.0711 <sup>‡</sup>     | (9.96)   | 0.0950 <sup>‡</sup>     | (14.08)  | NA                     |         | 0.114 <sup>‡</sup>       | (12.56)  |
| RELA CFU member              | −0.725 <sup>‡</sup>     | (−7.72)  | −0.392 <sup>‡</sup>     | (−5.27)  | 0.0245                 | (0.64)  | 0.248 <sup>†</sup>       | (2.46)   |
| RELA Older generation        | −0.980 <sup>‡</sup>     | (−3.75)  | −0.522 <sup>†</sup>     | (−2.31)  | 0.920 <sup>†</sup>     | (2.45)  | 0.536 <sup>†</sup>       | (1.98)   |
| RELA Siblings                | −0.189                  | (−1.02)  | 0.0654                  | (0.44)   | 0.248                  | (0.63)  | 0.769 <sup>‡</sup>       | (4.50)   |
| RELA Other Family            | −0.510 <sup>*</sup>     | (−1.73)  | 0.134                   | (0.46)   | 0.483                  | (1.27)  | 0.463                    | (1.54)   |
| RELA Servants                | −1.874 <sup>‡</sup>     | (−4.49)  | −0.166                  | (−0.88)  | NA                     | (2.78)  | −1.796 <sup>†</sup>      | (−2.49)  |
| RELA Working Title           | −1.351 <sup>‡</sup>     | (−3.98)  | 0.992                   | (1.41)   | 0.431                  | (0.39)  | 1.363                    | (1.25)   |
| RELA Lodger/Boarders         | −1.440 <sup>‡</sup>     | (−7.71)  | −0.677 <sup>‡</sup>     | (−4.56)  | −0.556                 | (−1.11) | −0.194                   | (−1.03)  |
| RELA Non-household           | −0.738 <sup>‡</sup>     | (−2.61)  | −0.578 <sup>†</sup>     | (−2.51)  | NA                     | (4.13)  | −0.115                   | (−0.56)  |
| Marital status Married       | −0.248 <sup>‡</sup>     | (−5.97)  | −0.0887 <sup>‡</sup>    | (−2.66)  | NA                     |         | −0.211 <sup>‡</sup>      | (−5.32)  |
| Agricultural land, Grade 1   | −0.00198                | (−1.59)  | 0.0106 <sup>‡</sup>     | (7.80)   | 0.0129                 | (1.41)  | 0.0119 <sup>‡</sup>      | (8.09)   |
| Agricultural land, Grade 2   | 0.00601 <sup>‡</sup>    | (6.27)   | 0.0149 <sup>‡</sup>     | (13.90)  | 0.0211 <sup>‡</sup>    | (2.68)  | 0.0169 <sup>‡</sup>      | (16.96)  |
| Agricultural land, Grade 3   | 0.00528 <sup>‡</sup>    | (5.94)   | 0.0153 <sup>‡</sup>     | (15.15)  | 0.0204 <sup>†</sup>    | (2.34)  | 0.0166 <sup>‡</sup>      | (17.16)  |
| Agricultural land, Grade 4   | 0.00308 <sup>‡</sup>    | (2.93)   | 0.00701 <sup>‡</sup>    | (6.25)   | 0.0217 <sup>†</sup>    | (2.46)  | 0.00829 <sup>‡</sup>     | (7.37)   |
| Distance to Town Centre      | −0.0000134 <sup>‡</sup> | (−3.57)  | −0.0000136 <sup>‡</sup> | (−3.67)  | 0.0000318 <sup>‡</sup> | (6.47)  | −0.00000807 <sup>†</sup> | (−2.11)  |
| Latitude                     | −0.166 <sup>‡</sup>     | (−10.60) | −0.136 <sup>‡</sup>     | (−12.31) | −0.144 <sup>‡</sup>    | (−5.78) | −0.271 <sup>‡</sup>      | (−30.87) |
| Longitude                    | 0.0343 <sup>‡</sup>     | (3.30)   | 0.0230 <sup>‡</sup>     | (2.79)   | 0.132 <sup>‡</sup>     | (9.54)  | 0.169 <sup>‡</sup>       | (25.40)  |
| Distance to rail lines       | −0.0000340 <sup>‡</sup> | (−6.85)  | −0.0000254 <sup>‡</sup> | (−4.97)  | −0.000007 <sup>‡</sup> | (−3.08) | −0.00000280              | (−0.37)  |
| r <sup>2</sup>               | 0.202                   |          | 0.309                   |          | 0.242                  |         | 0.301                    |          |
| N                            | 14,719                  |          | 14,869                  |          | 12,660                 |         | 14,287                   |          |

*Notes:*

t statistics in parentheses: \* p<0.10, † p<0.05, ‡ p<0.01.

For 1871 marital status unavailable and some RELA codes samples too small to estimate. Census variables are parish averages from individual data. Grades of agricultural land and transport variables at continuous parish level. Distance to Town Centre, Latitude, Longitude, and 1871 separate extraction at Registration Sub-District level.

Source: Authors' calculations from I-CeM/S&N data.

number of household *domestic* servants can be used as an imperfect surrogate for household income.<sup>64</sup> The estimates show that having a greater number of servants (and hence generally higher income) elevated the probability of being an employer. Hence employers and large farms were generally more likely to be headed by males in middle age and yielding higher incomes.

Being the head of a household had the highest likelihood of being an employer (the base category in the estimates, not shown). In comparison *all other* types of individual within the household for 1851 and 1861 have negative probabilities, indicating less probability of being a farm employer compared to the head. The least negative of these were members of the head's family (CFU), then lodgers or boarders, non-household members, and older generation, with the most unlikely being in-house domestic servants, as to be expected. There was a marked contrast for the later period for some household members. Although the number of farmers who were not heads is small and hence difficult to interpret, it is clear that members of the same family unit, older generation and siblings had a higher likelihood of being an employer (positive probabilities) by 1881, whereas they were previously negative. This suggests that in the face of increasing challenges, some heads were no longer the active farm proprietors but had either moved to waged employment in other industries, developed ancillary occupations, or had retired. This resulted in leaving other family members to manage the farm, primarily as own-account farmers. Under financial pressures a farmer could also diversify into other occupations using farm premises, rather than bolstering farm output through employing farm workers. This would reflect local market opportunities. Some suggestion of this is indicated by the decreasing size of the negative probability of employer status with having lodgers, which suggests some switching towards taking lodgers less out of necessity and more as a diversification strategy. Other analysis points to the development of multiple occupations by farmers in this period, especially by taking in lodgers.<sup>65</sup> For this, family support was critical, with the presence of a spouse and other family members a major explanatory variable in predicting the likelihood of individuals developing accommodation activities.

More generally, the role of spouses was a critical feature of the period. Married farmers, both male and female, were less likely to be employers than single people. Being married increased the probability of being own account. This at first sight seems counterintuitive. Marriage generally implies having additional resources to manage the house, which should make individuals more likely to be employers. However, the data contain elements of both explicit and disguised workforce support from spouses (and other family members). As noted at the outset, entrepreneur status can be confused in farming because many labour inputs can be provided within family farms by a spouse or family (and this was imperfectly recorded by census administrators). This means that married farmers have a potential reserve of labour that makes them less likely to become employers, other things held constant such as land quality and farm size. Hence, at a given size, a farmer could operate as a *de facto* own account by using access

<sup>64</sup> These are domestic live-in servants on census night; they *exclude* farm servants working on the farm, though there may have been some overlap between the two: Higgs, *Making sense*.

<sup>65</sup> D. Radicic, R. J. Bennett, and G. Newton,

'Portfolio entrepreneurship in farming: Empirical evidence from the 1881 census for England and Wales', *J. Rural Studies* 55 (2017), pp. 289–302; Bennett *et al.*, *Age of entrepreneurship*, ch. 11.

to unwaged labour inputs from a spouse or family. In historical case studies spouses have been argued to be important contributors to farming activity.<sup>66</sup> The effects are similar to modern studies which demonstrate the availability of input from farmer's wives to be inversely related to farm size, being over 20 times higher in the smallest farms than medium and larger sizes.<sup>67</sup> In our estimates there is a trend in this relationship, with the probability of being an employer decreasing for the married between 1851 and 1861 (though it remained highly significant), but under greater price pressures the probability returned by 1881 to approximately the same levels as in 1851. For 1871 it is not possible to estimate this effect, as marital status was not available in the I-CeM/S&N data. Recognition of these effects may also be increased in census data by some individuals not returning their spouse as employees, because they were not formally enumerated as workers, or because they were *de facto* partners and were co-own account (a status that the census was generally deficient in recording). No adequate attempt was made to allow for this in the UK census, but the US Census of Agriculture used a multiplier of 1.5 to adjust farm employment estimates for the inputs from spouse and family: as noted by Gregor 'small operators have always reacted to pressures ... by using their own labor prodigally'.<sup>68</sup>

The main geographical variables that we can estimate are land quality, transport access, and locational proxies for climate. Quality of agricultural land had important effects, as to be expected. In our estimates the land quality coefficients show that Grade 1 (best), Grade 2 (very good), Grade 3 (good) were strong predictors of employing agricultural labourers in the production function of the farm, except for 1851 where Grade 1 is negative but insignificant. The high-quality land grades are positive compared to the base level, Grade 5 (the worst kind of land). However, there were only small differences in land quality effects between the better grades (1–3) reflecting that all these were good land for agriculture with investment or effort if there was demand; but the poorest land (4, and 5) were normally least amenable to improvement and hence least likely to support a workforce. This indicates that employer status on better quality land varied as a result of improvements which were likely to reflect the location of the land relative to market opportunities.

This effect of market potential is strongly confirmed by the coefficient of Distance to Town Centre being mostly negative. The greater the distance, the poorer the access to markets, which decreased the likelihood of being an employer over being own account. Town Centres are defined from Law and Robson, who identified 934 towns of 2,500 or more inhabitants and a density of more than one person per acre.<sup>69</sup> Similarly, poorer transport access, measured by Distance to Rail Line from the centre of each parish, decreases the probability of employer entrepreneurship. Our estimates confirm at national scale previous case studies.

<sup>66</sup> Anderson, 'Family structure'; M. Winstanley, 'Industrialization and the small farm: Family and household economy in nineteenth-century Lancashire', *Past and Present* 152 (1996), pp. 157–95; Davidoff and Hall, *Family fortunes*.

<sup>67</sup> R. Gasson, 'Farmers' Wives – their contribution to the farm business', *J. Agricultural Economics* 43 (1992), pp. 74–87; Errington and Gasson, 'Labour use'.

<sup>68</sup> H. F. Gregor, *Industrialization of U.S. Agriculture:*

*An interpretive atlas* (1982), pp. 99, 25.

<sup>69</sup> C. M. Law, 'The growth of urban population in England and Wales, 1801–1911', *Trans. Institute of British Geographers* 41 (1967), pp. 125–43; B. Robson, *Urban growth: An approach* (1973). Database: R. J. Bennett, *Urban population database, 1801–1911* (2012) [data collection]. UK Data Service. SN. 7154, dx.doi.org/10.5255/UKDA-SN-7154-1; C. Law, B. Robson, J. Langton [original data producers].



As Schwartz found in a Dorset case study of the effects of the depression, farmers with rail access maintained, expanded, or diversified production compared to those who had no or little access.<sup>70</sup> Other case studies that do not cover the depression also show that poor access reduced the extent to which farm workers were employed.<sup>71</sup> We also tested the effect of other transport variables in the cross-sections: distance to railway stations, distance to main road, and distance to waterways. They show similar effects to that for distance to rail line when used separately, but the rail line variable was the strongest predictor.

The model also takes account of climate effects known to be important for agriculture.<sup>72</sup> Latitude is a proxy for temperature: the further north, the colder the weather. It is also a proxy for elevation as generally speaking, higher land is located further north. The coefficient is significant for all years and negative, as expected, i.e. the more northerly and more elevated, the colder the farm, the lower its likely output, and the less likely it was to have scope for large employment. The more elevated north had a lower proportion of employers to own account than the warmer and less elevated south. Longitude in England and Wales primarily represents changes in moisture as generally rain-bearing winds come from the south west. The variable is measured as distance from the east so that a positive coefficient indicates that more productive lands are where rainfall moderates. A key Ministry of Agriculture Fisheries and Food report states that 'in climatic terms, the poorest areas are both the wettest and coldest and conversely the climate is regarded as more favourable as temperature increases and rainfall moderates'.<sup>73</sup> As a result, the south and east present a more favourable climate for land productivity, being warmer, less elevated and moderately drier. This is confirmed in our results, which show that the south and east have greater scope for large farm employment rather than own account as the leading entrepreneurial type. Latitude and longitude are approximations that could be developed in any subsequent analysis to include climate and elevation data explicitly.

The overall conclusion to be drawn from the cross-sectional estimates is that our main research expectation is confirmed: that Total Employees and Acreages mutually adjusted, and this was finely spatially variegated. Given there were rigidities in the land market that limited the adjustment of farm acreage, the main response came through the entrepreneurial decision whether or not to hire labour. The probability of being an employer first increased slightly from 1851 to 1861 and then reduced, dropping in 1871, and then again by 1881, which aligns with the timing of the 'Golden Age' and growing challenges, including the agricultural depression. As Grigg argued, the actual farm sizes in this period did not change greatly;<sup>74</sup> instead we demonstrate that the number of employees was a significant adjust mechanism, especially at the cut-off margin we map between having employees at all and operating on own account. This change could have been driven either by entrepreneurial choice, employers deciding to cut their workforce, or by labour market forces that increased labour costs and reduced the labour pool by workers migrating from agricultural areas to find alternative employment. As

<sup>70</sup> R. M. Schwartz, 'Rail transport, agrarian crisis, and the restructuring of agriculture', *Social Science Hist.* 34, (2010), pp. 229–55.

<sup>71</sup> E.g. Anderson, 'Family structure'; Winstanley, 'Industrialisation'.

<sup>72</sup> E.g. Grigg, *English agriculture*, pp. 28–37.

<sup>73</sup> Ministry of Agriculture Fisheries and Food, *Agricultural land classification*, p. 11.

<sup>74</sup> Grigg, 'Farm size', p. 183.

shown in Figures 1 and 2, the decline in the numbers of agricultural labourers began before the onset of the agricultural depression. The labour market tightened over the period, as reflected in a general increase in wages across England and Wales, in both high- and low-wage areas. During the depression agricultural wages were stable or rose.<sup>75</sup> Consequently, while migration away from rural areas forced some farmers to decrease their workforce size, increasing wages combined with squeezed profits was most important. This gives a new answer to the question posed by Collins as to whether farm business strategy was short-term or chronic.<sup>76</sup> The adjustment appears to have been mostly strategic through a different approach to using home, spouse and family resources. It was also geographically highly variegated. Our range of control variables confirms the significant effect on entrepreneurial choices of land quality, and location relative to urban centres or rail lines that provided access to urban markets. Climate was an important secondary variable, whilst demographic features of a farmer's age, gender, and income also played significant roles.

#### IV

The cross-sectional estimates reveal much about the effect of economic changes on entrepreneurship choices. But the spatial units used vary for each time slice due to changes in parish boundaries.<sup>77</sup> This could have distortionary effects on the estimates. To check the robustness of the cross-sections, the data are re-estimated with a panel. The same entrepreneurial and demographic variables are used (age, gender, marital status, relationship to the head), but the estimation is now undertaken for a panel of parishes with consistent boundaries across all years. These are aggregations of the original parish units to form the smallest homogeneous geographical units that are continuous between 1851 and 1891, thus avoiding the effects of boundary changes. These aligned boundaries follow the method developed used by Wrigley for the early censuses.<sup>78</sup> There are 12,552 continuous parishes, of which 11,764 contain farmers for all years. These cover the whole of England and Wales, meaning that we work with a complete geographical coverage for each year. The panel allows the use of fixed effects to control for unobservable variables for individual geographical units, such as capital intensity which is not available in any of the data for the period at this level of granularity. The only limitation of the panel approach is that all invariant controls are dropped; similarly, data for all time slices are pooled into one estimate.

The estimates of the panel model at continuous parish level (ConPar) are shown in Table 4. The model of the entrepreneurial equation with demographic controls (which vary between years) is as follows:

$$\log \frac{Eh_{i,j} + 1}{Es_{i,j} + 1} = \beta_A A_{i,j} + \beta_L L_{i,j} + \beta_{Demographics} Demographics_{i,j} + \varepsilon_{i,j}$$

( $i = ConPar, j = years$ )

<sup>75</sup> Dauntton, *Wealth and welfare*, p. 47; E. H. Hunt, 'Labour productivity in English agriculture, 1850–1914', *ECHR*, 20 (1967), pp. 280–92; Turner, 'Agricultural output, income and productivity', pp. 272–7.

<sup>76</sup> Collins, 'Rural and agricultural change', p. 157.

<sup>77</sup> Higgs, *Making sense*.

<sup>78</sup> E. A. Wrigley, *The early English censuses* (2011).

TABLE 4. Estimates of Log E/OA using continuous parish level panel data (11,764 parishes in each year) with reghdf

|                      | (1)        |          |
|----------------------|------------|----------|
|                      | IEOA       |          |
| Total Employees      | 0.00221*   | (4.71)   |
| Acreage              | 0.0000462* | (2.75)   |
| Age                  | 0.0393*    | (7.47)   |
| Age x Age            | -0.000383* | (-7.37)  |
| Sex Male             | 0.0358     | (0.99)   |
| RELA 10 CFU          | -0.189*    | (-3.66)  |
| RELA 10 Older        | 0.0847     | (0.58)   |
| RELA 10 Sibl         | -0.0297    | (-0.20)  |
| RELA 10 Other Family | 0.0183     | (0.11)   |
| RELA 10 Servant      | -0.342     | (-1.25)  |
| RELA 10 WorkingTitle | -0.145     | (-0.67)  |
| RELA 10 LodgBoard    | -0.454*    | (-3.65)  |
| RELA 10 Nonhousehold | -0.315*    | (-1.91)  |
| 1861                 | 0.113*     | (10.06)  |
| 1871                 | -0.012     | (-0.83)  |
| 1881                 | -0.157*    | (-12.99) |
| r2                   | 0.601      |          |
| N                    | 47,058     |          |

Note: t statistics in parentheses; \* p<0.10, † p<0.05, ‡ p<0.01.

Source: Authors' calculations from I-CeM/S&N data.

The estimation is run with the Stata command *reghdfe* (high dimensional fixed effect panel data) with continuous parishes and year fixed effects, with standard error clustered at the continuous parish level.<sup>79</sup> This command has been recently made available by Correia.<sup>80</sup> The p-values of the causal variables Acreages (A) and Total Employees (L) are positive and both highly significant. They are also within the credible range, and similar to those for the cross-sections. The controls are all significant and also in a credible range. As before,

<sup>79</sup> This estimator uses clustered standard errors because some observations are related to each other within a group, so that an unobservable is similar for group members. In our case, unobserved traits like the opportunities of farmers are expected to be similar within a parish and dissimilar between parishes. The estimator takes this into account.

<sup>80</sup> S. Correia, *reghdfe: Stata Module for Linear and*

*Instrumental-Variable/Gmm Regression Absorbing Multiple Levels of Fixed Effects*, Statistical Software Components s457874 (2017). This approach is used because the panel data at the continuous parish level have 48,000 observations with more than 12,000 factor variables which exceed the upper limit of matrix size of 11,000. This package absorbs the fixed effects, so there is no need to invert a matrix bigger than the Stata current limits.

greater age increased the probability of being an employer but this diminished at higher ages through the negative second order term. Males again had higher probability of employer entrepreneurship. At the same time, the probability of being an employer was less likely where there were internal resources from other household members, particularly where the farm was run by a member of the conjugal family unit (CFU), or there were lodgers. The positive but insignificant coefficient for older family members than the head of household indicates that the headship of the house had passed to others and younger household members were the main operatives. Marital status cannot be estimated as this variable is not available for the 1871 data. However, although the role of spouses cannot be estimated, as before, having other family available indicates the effect of disguised family inputs that were not fully measured.

These features confirm the same patterns as the cross sections, and establish the robustness of the conclusions drawn. The specification confirms that, after controlling for demographic and other variables, acreages (the quantity of the input land) critically affect the ratio between employer and own account entrepreneurship: an increase of 50 farm acres in the parish causes a 0.3 per cent increase in the ratio of employers to own account<sup>81</sup>

Finally, if we add year dummies as explicit fixed effects, the results are as expected. 1851 as the base year is omitted; 1861 is strongly positive in comparison, increasing employer probability from 1851, which means they register the 'Golden Age' effect; 1871 is not significant, reflecting its intermediate status at a turning point and perhaps the poorer data available; and 1881 is strongly negative, registering the depression effect. All this is as expected and constitutes a robustness check for the cross-sectional estimates.

## V

Following the work of Grigg, it is possible to add to our analysis an assessment of farm size changes between 1851 and 1881. This is an important contribution because almost all previous large-scale analyses have used farm holdings, whereas our analysis is able to focus on the most relevant entrepreneurial unit – the farm. The farm is a business, whereas different numbers of parcels or holdings were likely to have confused links to entrepreneurship. This explains the fact that while Grigg's data show over 300,000 holdings in each year examined between 1870 and 1935, the census data contained only two-thirds of this number of farms.<sup>81</sup>

Tables 5 and 6 gives the farm size distribution for each year provided by the census data. Table 5 gives the summary statistics for all farms between 5 and 1,500 acres in order to eliminate outliers. Table 6 shows the breakdown banded by size. For farms smaller than 100 acres the average number of employees was usually two or fewer, while farms between 100 and 300 acres employed two to four workers, for 300–500 acres the workforce was approximately ten, and for farms over 500 acres it was twenty or more. Note that data on the smallest farms of 0–5 are given for completeness, but should be treated as unreliable, as noted earlier.<sup>82</sup>

<sup>81</sup> Grigg, 'Farm size', Table 1.

<sup>82</sup> Ibid.

TABLE 5. Summary statistics for acres and total employees of farms in England and Wales for years for farms with over 5 and less than 1,500 acres; employees only for farmers with non-zero employees

|      | Acres    |             |            |            |               | Total Employees |             |            |            |               |
|------|----------|-------------|------------|------------|---------------|-----------------|-------------|------------|------------|---------------|
|      | <i>N</i> | <i>mean</i> | <i>min</i> | <i>max</i> | <i>median</i> | <i>N</i>        | <i>mean</i> | <i>min</i> | <i>max</i> | <i>median</i> |
| 1851 | 164,792  | 120         | 6          | 1,491      | 78            | 109,056         | 5           | 1          | 1,044      | 3             |
| 1861 | 171,348  | 116         | 6          | 1,460      | 70            | 92,246          | 6           | 1          | 951        | 4             |
| 1871 | 161,316  | 119         | 6          | 1,487      | 70            | 72,640          | 6           | 1          | 213        | 4             |
| 1881 | 174,166  | 122         | 5          | 1,488      | 70            | 81,993          | 6           | 1          | 3,500      | 3             |

Source: Authors' calculations from I-CeM/S&N data.

Most interesting is change over time. For most farms the option to change size was limited, only occurring at the margin when additional holdings became available in a convenient location. This occurred infrequently but more often in the depression. The very small changes to acreage in each category show that change in farm size was indeed very slow and mostly restricted to the largest farms. Small average acreage increases occurred in all categories over 50 acres. The largest size increases occurred on the largest farm categories (over 500 acres), and this was mainly at the end of the period after the onset of the depression. Hence farm size changes, such as they were, lagged the adjustment to increased own account farming.

Similarly, the average Total Employees employed generally decreased from a peak in 1851, as expected from the general decline in the agricultural labour force. But there were important differences for different farm size categories. Ignoring the problematic 0–5 category, there was a small increase between 1851 and 1861 for farms of 20–50 acres while all other size categories saw a continuous decrease from 1851 onwards. This general decrease in employee numbers, when compared with the statistics on relatively stable farm output for the period,<sup>83</sup> indicates increased productivity and greater capital-intensity. At the same time, the probability of being an employer (Ees) decreased after 1851 for all sizes of farms below 50 acres (excluding the 0–5 acre farms); and this continued in the later years up to 1881. But it decreased by the largest amount for smallest farms, where own account entrepreneurship was most viable; hence the smallest farms were most likely to shift to own account – which is an expected result since they would be closer to production margins. For the medium and larger farms of over 50 acres the probability of being an employer initially decreased, but then showed a small increase between 1871 and 1881. It was generally greatest for the over 300 acre categories.

<sup>83</sup> Feinstein, *National income*, Table 8; Turner, 'Agricultural output, income and productivity', Figs. 3.15 and 3.17.

TABLE 6. Summary of statistics by year for farm size, acreage, number of employees, and model estimates of probability of being an employer or own account

| <i>Year</i> | <i>Farm size employees</i> | <i>Acreage</i> | <i>Mean no. of Employees</i> | <i>Ees</i> | <i>Log E/OA</i> | <i>N of farms</i> |
|-------------|----------------------------|----------------|------------------------------|------------|-----------------|-------------------|
| 1851        | 0–5                        | 0.164001       | 0.284875                     | 0.034468   | –1.03075        | 69652             |
| 1861        | 0–5                        | 0.22582        | 0.524979                     | 0.084587   | 0.089891        | 56368             |
| 1871        | 0–5                        | 1.93917        | 2.35401                      | 0.356916   | 0.131865        | 7562              |
| 1881        | 0–5                        | 0.27075        | 2.52871                      | 0.12631    | 0.811577        | 55142             |
| 1851        | 5–20                       | 11.42          | 0.399585                     | 0.193126   | 0.206495        | 26117             |
| 1861        | 5–20                       | 11.5186        | 0.375839                     | 0.138262   | –0.22662        | 30529             |
| 1871        | 5–20                       | 11.2884        | 0.269961                     | 0.100385   | –0.81615        | 31449             |
| 1881        | 5–20                       | 11.4514        | 0.193639                     | 0.090835   | –1.03721        | 32917             |
| 1851        | 20–50                      | 32.1138        | 0.989783                     | 0.478838   | 1.534968        | 33932             |
| 1861        | 20–50                      | 31.8642        | 1.00149                      | 0.345772   | 0.775851        | 38349             |
| 1871        | 20–50                      | 31.9313        | 0.704168                     | 0.270536   | –0.00775        | 35145             |
| 1881        | 20–50                      | 31.9485        | 0.546777                     | 0.259041   | –0.06631        | 37743             |
| 1851        | 50–100                     | 69.9843        | 1.82472                      | 0.702079   | 2.667138        | 35950             |
| 1861        | 50–100                     | 69.507         | 1.73958                      | 0.562516   | 1.816416        | 35439             |
| 1871        | 50–100                     | 69.8627        | 1.3963                       | 0.462667   | 0.903749        | 32304             |
| 1881        | 50–100                     | 70.0629        | 1.18835                      | 0.471774   | 1.023895        | 35180             |
| 1851        | 100–300                    | 164.921        | 4.46987                      | 0.874104   | 4.333271        | 55860             |
| 1861        | 100–300                    | 165.32         | 4.46337                      | 0.776499   | 3.36856         | 53530             |
| 1871        | 100–300                    | 166.767        | 3.75933                      | 0.668538   | 1.885028        | 49345             |
| 1881        | 100–300                    | 168.111        | 3.46793                      | 0.711756   | 2.514745        | 52799             |
| 1851        | 300–500                    | 361.304        | 11.2079                      | 0.944911   | 5.681342        | 10323             |
| 1861        | 300–500                    | 361.826        | 10.7516                      | 0.883793   | 5.313206        | 10662             |
| 1871        | 300–500                    | 364.625        | 9.37021                      | 0.789134   | 2.486032        | 10675             |
| 1881        | 300–500                    | 365.073        | 9.09431                      | 0.863959   | 4.246762        | 11695             |
| 1851        | 500–1500                   | 684.009        | 21.4092                      | 0.939919   | 5.127292        | 4247              |
| 1861        | 500–1500                   | 688.454        | 19.527                       | 0.878834   | 5.645447        | 4564              |
| 1871        | 500–1500                   | 694.403        | 17.0785                      | 0.783309   | 2.477035        | 4841              |
| 1881        | 500–1500                   | 711.455        | 18.947                       | 0.888732   | 4.974255        | 5680              |
| 1851        | 1500–11500                 | 2637.33        | 30.7174                      | 0.907834   | –0.4821         | 778               |
| 1861        | 1500–72000                 | 3189.313       | 28.4474                      | 0.820175   | 4.727388        | 228               |
| 1871        | 1500–80000                 | 2112.04        | 26.2488                      | 0.770335   | 2.70805         | 209               |
| 1881        | 1500–30000                 | 2822.886       | 26.5841                      | 0.764526   | 3.822411        | 327               |

*Note:* Number of farms is the total observations N in each size class. Note, 0–5 employee category given only for completeness; these data should be treated as unreliable as described in the text.

*Source:* Authors' calculations from I-CeM/S&N data.



## VI

This paper has begun a process of analysis with the new data available from digitized versions of the census. Further research with these data will be able to take some research questions further than it has been possible here. Here we have focused on the neglected aspect of changes in the dominant forms of farm entrepreneurship: showing a major shift from employer to own account after 1861. Technical change and increased mechanisation, competition from industrial wages and returns on investment, abolition of protective tariffs, reduced cost of shipping, and the growth of highly competitively priced food imports from America, Russia and Australasia, as well as other factors, presented critical challenges for British farms in the mid-nineteenth century. The paper has used four cross-sections of the long-term changes over the 30 years 1851–81 to show that important changes occurred in the 1860s, well before the agricultural depression of the 1870s. Over 1861–71 it has been shown that a major shift of farm businesses occurred, first towards own-account sole proprietors, and then after 1871 both entrepreneur types declined. This was a tipping point towards more modern farming where operating as individuals has become the norm, with no other regular labour inputs, except perhaps part-time spouses, family or other occasional inputs. The paper has confirmed that farmers generally tried to avoid hiring others, and that under extreme price pressures and using technical developments, they increasingly opted for own-account status and shed all employees. In other research we show that the 1860s was the critical long-term change point for farm entrepreneurship: subsequently own account farming continued to increase rapidly until 1900, before starting to decline; however, employer numbers began to recover in 1891 and showed an uneven increase over time up to 1911.<sup>84</sup>

The paper has also confirmed, by estimating a range of control variables, the effects of land quality, location relative to urban centres or rail lines that provided access to urban markets, climate, and demographic features of a farmer's age, gender, availability of other inputs through marital status and family members, and wealth effects. The robustness of the cross-sectional effects is confirmed by a panel estimation which holds local units of analysis constant over time. These controls demonstrate, at parish level, the variegated effects of geography across the country, allowing a much more nuanced assessment of regional and local changes than has been previously possible. We find farm employers mostly able to maintain their status as employers, albeit while reducing their workforce size in the south and east. There, the ratio of employers to own account increased slightly between 1851 and 1861 and was generally maintained after 1871, whilst in the north and west farmers were more likely to become own account and cut their employees so that the ratio of employers to own account significantly decreased by 1871 and 1881. In doing so farmers in the north were reverting to a form of family-based own-account farming which had been common in 1851 but which had long been rarer in the south and east of England.

The paper has been able to add more robust understanding of farm size adjustments for the period, previously impossible at a national level because complete census records were

<sup>84</sup> R. J. Bennett, H. Smith, and P. Montebruno, 'The population of non-corporate business proprietors in England and Wales, 1891–1911', forthcoming in *Business Hist.*, Tables 8 and 9.

unpublished and the *Agricultural Statistics* were restricted to holdings rather than farms, and only from 1866. The panel data indicate that an increase of 50 farm acres in the parish led to a 0.3 per cent increase in the ratio between employers and own account entrepreneurs, and an increase of five employees in the parish led to an increase of 0.1 per cent in this ratio, all other factors held constant. Farm acreage changed only slowly, but for all size groups from 20–50 acres upwards, where farmers could acquire large holdings, they did increase farm sizes somewhat, albeit they worked such land with reduced labour.

The results of the analysis also allow more general commentary on the effect of macro-economic changes. The agricultural depression after 1873 saw an acceleration of the decline in the agricultural workforce; however, farmer numbers reduced only slowly. The land asset or tenancy of farms is all that many individuals had available. They could have given this up for waged employment if it was available, which may have not been possible and may have required migration to urban areas. For many individuals the option of adapting their use of the land and becoming own account offered more assured futures than the alternatives available, even if income potential was small and increasing price competition led them to becoming essentially 'survival' entrepreneurs. The pressures experienced by farmers after our period of analysis continued this challenge and increased the importance of entrepreneurial choice, with own account becoming more dominant into the twentieth century. The evolution over 1851–81 has not been previously fully examined. The reduction in employer entrepreneurship we have shown, and the shift towards greater numbers of own-account operators (perhaps supported by part-time spouse and family labour where this was available) was a major response which began in this early period. However, responses varied. Some small farmers, where they were located close to urban areas, or had transport access that opened new market opportunities, could benefit. The message of this period was therefore mixed: indicating a strong survival of the farmer and the farm unit, but a severe diminution of its potential to employ others, with very variable fortunes depending on access to markets.

Our findings thus provide a different conclusion to some previous historical studies that have argued that farmers failed in this period. These writers have argued that when faced with challenges, farmers were unwilling, or were unable, to adapt; for example, that rather than shifting to dairy and meat farming, they stuck to unprofitable wheat for too long instead. These failures have been blamed variously on ignorance, conservatism, the risk-aversion of landlords, or the restrictive nature of the tenurial system which held farmers back because, as tenants, they had little incentive or ability to develop new methods for raising productivity and output.<sup>85</sup> Our findings instead support Hunt and Pam and others who have argued that farmers and landlords in this period were often flexible, and dealt with the situation as best they could, given the constraints of the tenurial system and the limited and risky opportunities available for arable farmers to move into high-yield alternatives, such as dairy and high-quality meat production.<sup>86</sup> Our conclusions generally support a more optimistic interpretation of the robustness of farmers,

<sup>85</sup> C. P. Kindleberger, *Economic growth in France and Britain, 1851–1950* (1964); A. Offer, *The First World War: an agrarian interpretation* (1989); P. J. Perry, *British farming in the Great Depression* (1974).

<sup>86</sup> E. H. Hunt and S. J. Pam, 'Responding to agricultural depression, 1873–96: managerial success, entrepreneurial failure?', *AgHR* 50 (2002), pp. 225–52.

especially those with small or medium-sized 'family farms'. These proved adaptable and resilient to change through shifts in entrepreneurial status and greater involvement of the family in the farm. Larger farms also began to make important changes by limited expansion, but generally more slowly than smaller farmers and only at the end of our period.

### Appendix I:

#### Calculation of the cut-off and listing of cut-offs by Registration District.

A model is used to estimate the probability of the correct reporting of employees for those farmers who failed to provide employee numbers and only gave acres. This uses the acreage and employees of those farms that returned both data. This is estimated for each of 623–630 Registration Districts (RDs). The model estimated is:  $\text{Logit}(E) = \beta \text{Acres}$ . The model produces for each RD a sigmoid cumulative probability function. On this curve there is a cut-off, found by inverting the logistic function. An example is illustrated in Figure A.1, where the cut-off corresponds to the median, or 'mid-aggregate point'. This was suggested by Lund and Price (1998) as the best measure of farm size differences since it is not distorted by extreme values.<sup>87</sup> Farm size in most countries is a truncated lognormal distribution,<sup>88</sup> and the use of a logistic initiated in a seminal paper on farming by Nerlove and Press, responded to the difficulties of effectively measuring central tendency in such data.<sup>89</sup>

The actual estimates of cut-off for each RD were calibrated by testing the best fit of the predicted number of employers and own account to those observed in the population for each year. This was, on average 0.25, the point at and above which a farmer can be expected to employ others, which varies greatly by location. The estimate was tested for robustness by mapping a variety of cut-offs and checking the differences in the number of employer farmers. In the range of 0.25 – 0.5 the geography does not change, indicating that choice of cut-off correctly confronts the margin between employers and own account. In detail the model is estimated as follows. The cut-off is found from the inverse of the logit function. The logit model is:

$$y = \frac{e^{\alpha + \beta x}}{1 + e^{\alpha + \beta x}}$$

Starting from this equation, Its inverse is calculated as follows:

$$y = \frac{e^{\alpha + \beta x}}{1 + e^{\alpha + \beta x}}$$

$$y + ye^{\alpha + \beta x} = e^{\alpha + \beta x}$$

<sup>87</sup> P. Lund and R. Price, 'The measurement of average farm size', *J. Agricultural Economics* 49 (1998), pp. 100–10.

<sup>88</sup> P. Allanson, 'Farm size structure in England and Wales, 1939–89', *J. Agricultural Economics* 43 (1992)

pp. 137–48.

<sup>89</sup> I. Nerlove, and S. J. Press, *Univariate and Multivariate Log-Linear and Logistic Models*, Santa Monica, CA., RAND Corporation, R-1306-EDA/NIH (1973).

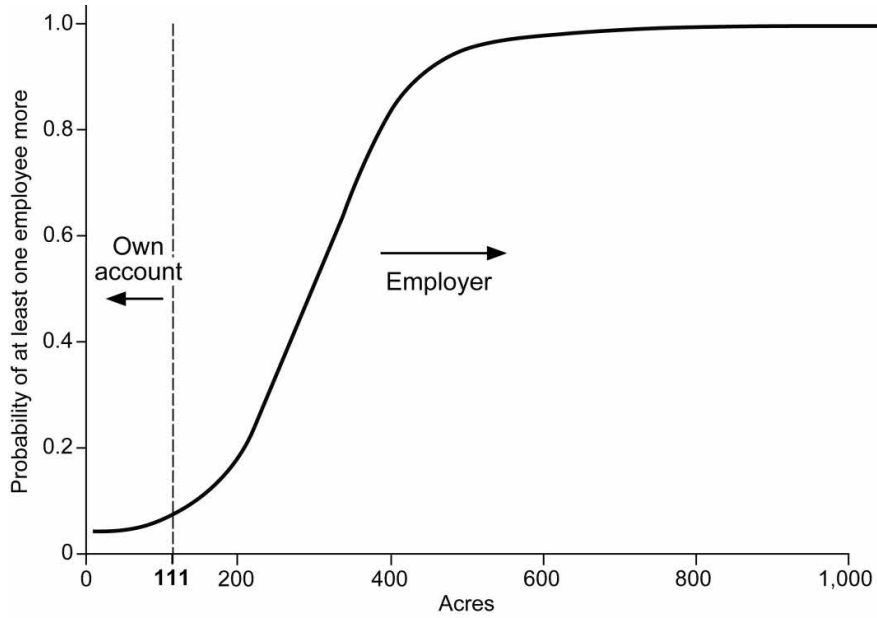


FIGURE A.1. Example of the mid-aggregate point cut-off (in acres) of the logistic function (illustrated for the England and Wales average of 111 acres)

Source: Authors' calculations from I-CeM/S&N data.

$$y = e^{\alpha + \beta x} (1 - y)$$

$$\frac{y}{1 - y} = e^{\alpha + \beta x}$$

$$\ln \left( \frac{y}{1 - y} \right) = \alpha + \beta x$$

Which gives the inverse:

$$x = \frac{-\alpha + \ln \left( \frac{y}{1 - y} \right)}{\beta}$$

Evaluating this inverse at  $y = 0.5$ , the  $\ln(y/1 - y)$  vanishes. Thus, the result is simply:

$$x = -\frac{\alpha}{\beta}$$

The cut-off (Figure A.1) shows two clouds of points: one along the Y-axis for the variable E being one (where all farmers are employers, above a certain acreage), and one for E being zero

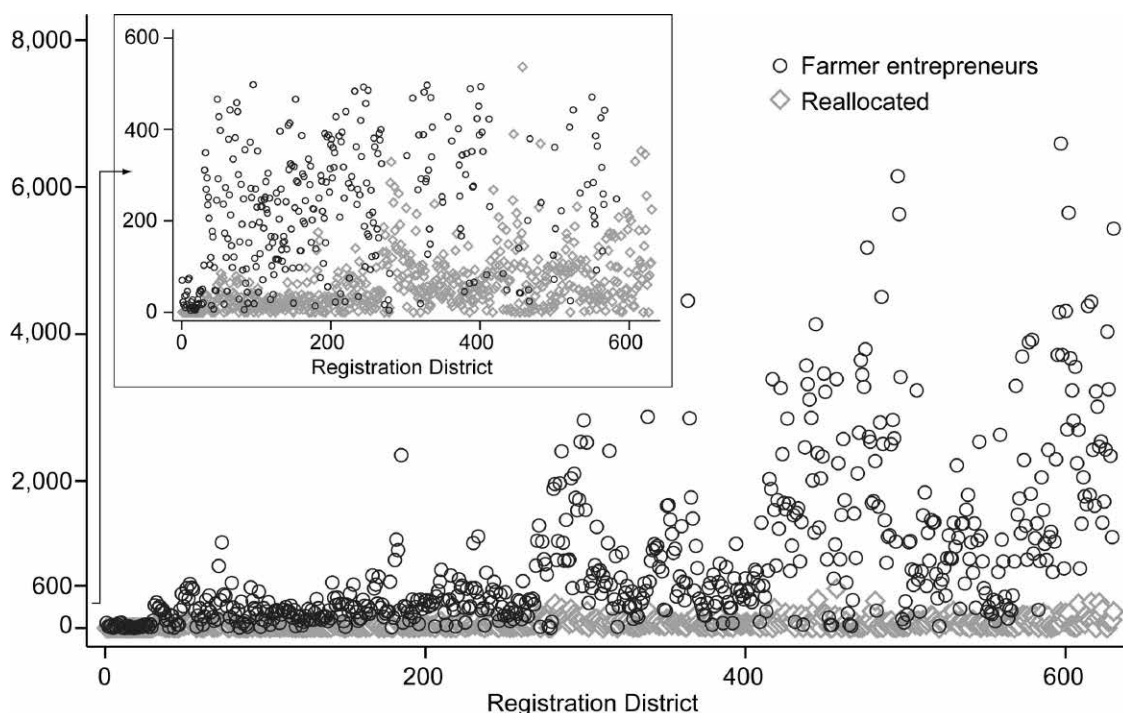


FIGURE A.2. Frequency distribution of number of all farm entrepreneurs (Employers plus Own-account) (black points) in each of the 630 Registration Districts, and farmers reallocated to employer status by the logit model (grey diamonds). Data ordered by Registration District code. Close-up: same variables, but only for RDs with less than 500 total farm entrepreneurs; example for 1881.

Source: Authors' calculations from I-CeM/S&N data.

(where all farmers are own account, below a certain acreage). The sigmoid curve is generally right-facing; i.e. the coefficient for acres is positive. Also for some districts the farmers are *all* either employers (which are assigned a probability of 1), or *all* own account (assigned a probability of zero). Outliers are dropped in a few cases to achieve convergence. The frequency distribution of the farmer responses who gave only acres, and those reallocated to employer status based on their acres is shown in Figure A.2. The reallocation is distributed widely across all RDs, mostly in small numbers in each case.

## Appendix II: Data acknowledgements

The data used for 1851-61 and 1881 derive from K. Schürer, E. Higgs, A. M. Reid and E. M. Garrett, *Integrated Census Microdata, 1851-1911, version V. 2 (I-CeM.2)*, [data collection]. UK Data Service, SN: 7481, [dx.doi.org/10.5255/UKDA-SN-7481-1](https://dx.doi.org/10.5255/UKDA-SN-7481-1) (2016); see E. Higgs, C. Jones, K. Schürer and A. Wilkinson, *Integrated Census Microdata (I-CeM) Guide* (sec. edn, 2015). The 1871 census data were provided by S&N (TheGenealogist).

The GIS boundary files for RSDs were constructed by Joe Day for the ESRC fertility project directed by Alice Reid: [www.geog.cam.ac.uk/research/projects/victorianfertilitydecline/publications.html](http://www.geog.cam.ac.uk/research/projects/victorianfertilitydecline/publications.html)

RD boundaries are an aggregation of these files. RSD and GIS parish files, developed from A. E. M. Satchell, P. Kitson, G. Newton, L. Shaw-Taylor and E. A. Wrigley, *1851 England and Wales census parishes, townships and places* (2006), ESRC RES-000-23-1579, supported by Leverhulme Trust and the British Academy; A. E. M. Satchell, *England and Wales census parishes, townships and places* (2015), which is an enhanced and corrected version of N. Burton, J. Westwood and P. Carter, *GIS of the ancient parishes of England and Wales, 1500-1850* (2014), UKDA, SN 4828; which in turn is a GIS version of R. J. P. Kain and R. P. Oliver, *Historic parishes of England and Wales: An electronic map of boundaries before 1850 with a gazetteer and metadata* (2001) UKDA, SN 4348.

The rail data have been coded to parishes using the GIS files from J. Martí-Henneberg, A. E. M. Satchell, X. You, L. Shaw-Taylor and E. A. Wrigley, 'England, Wales and Scotland railway stations 1807–1994 shapefile' (2017); which is an enhanced version of J. Martí-Henneberg, F. Tapiador, A. E. M. Satchell, L. Shaw-Taylor, and E. A. Wrigley, 'Lines of England and Wales, 1807–1994 dynamic GIS shapefile' (2008); this dataset is a GIS digitization of the rail lines in M. H. Cobb, *The railways of Great Britain, a historical atlas at the scale of 1 inch to 1 mile* (2 vols, 2005).